Bayou Queue de Tortue Implementation Plan for Dissolved Oxygen and Nitrogen, Total Suspended Solids, Total Dissolved Solids and Turbidity

EXECUTIVE SUMMARY

The Bayou Queue de Tortue (050501) watershed is 305 sq miles and the main agricultural practices in the watershed consist of rice, soybeans, pasture, and a small amount of sugarcane. In order to achieve pollutant load reductions, as prescribed in the TMDLs, rice farmers will have to reduce the spring discharge of muddy water. Watershed modeling indicates that the rice field discharges, after mudding in and planting, represent >60% of the NPS pollutant loading in the watershed. Over two decades of water quality monitoring on the Queue de Tortue validate the results from the model. Historical data demonstrate a large spike in pollutants during the spring months which coincides with rice field leveling and planting. The incorporation of Best Management Practices (BMPs), such as precision leveling and dry field planting, should eliminate the spring rice discharges and should bring the watershed into compliance with the DO, TSS, TDS, and turbidity TMDLs. Also, the installation of riparian areas along the Bayou Queue de Tortue and its tributaries would significantly reduce pollutant loading to the waterway. Cost sharing for riparian BMPs are discussed in this plan and areas where riparian zones should be installed are presented as well. Methods to reduce the amount of sediments from entering the waterway and improving or restoring riparian areas should reduce the loading of oxygen demanding substances, turbid substances, dissolved and suspended solids which suspend in the water column.

Table Of Contents

1.0 IMPLEMENTATION PLAN FOR DISSOLVED OXYGEN, NUTRIENTS, TOTAL SUSPENDED SOLIDS, TOTAL DISSOLVED SOLIDS, AND TURBIDITY IN THE BAYOU QUEUE DE TORTUE WATERSHED

1.1 INTRODUCTION

A TMDL is an acronym for Total Maximum Daily Load, which is the maximum amount of a pollutant that a water body can assimilate and still meet water quality standards for its designated uses. If the water body does not meet the standard for a particular use a set percentage of the time (depending on the standard) it is placed on the State of Louisiana's 303(d) List of Impaired Waters. The bayou was listed on the 1998 303(d), and the 1999 Court Ordered Impaired lists as not meeting its uses for fish and wildlife propagation. TMDLs were required to be completed on all remaining sources of impairment for Bayou Queue de Tortue (Sub-segment 050501). The Louisiana Department of Environmental Quality (LDEQ) has completed a TMDL for organic enrichment/low DO. The U.S. Environmental Protection Agency (USEPA) Region 6 has completed and released TMDLs for turbidity, total suspended solids (TSS), and total dissolved solids (TDS).

An Implementation Plan describes a plan of action to reduce NPS pollution in the watershed until the streams and rivers will comply with water quality standards. These plans will be the basis for outlining how and where the State's NPS Program focuses its efforts and future resources within the watershed in order to achieve use attainment by the year 2008, as agreed upon with EPA. In agricultural watersheds, such as the Queue de Tortue, the implementation of conservation tillage, riparian zones, and precision farming (BMPs) are the recommended course of action for reducing pollutant runoff from row crops, rice, and pasture. Recent innovations in rice BMPs should prove to be a winning strategy for reducing NPS pollution in the watershed as much as 60%. Hydro modification, home sewerage, and urban runoff also contribute to low DO conditions and high levels of TSS, turbidity, and TDS. BMPs for these NPS pollutant sources will be presented in this plan as well.

1.2 LDEQ D ISSOLVED OXYGEN AND NUTRIENT TMDL FINDINGS

The DO TMDL reported that NPS pollution accounts for ~89% of the anthropogenic pollution and point sources accounts for ~1% and natural background sources are responsible for the remaining 10% of oxygen demanding substances in the waterway. The TMDL estimates that compliance with the criteria 5 mg/l (winter) and 3mg/l (summer) will require a 60 % reduction of man-made NPS pollution. Agricultural activities account for 86.7% of the total landmass in the watershed. The TMDL also issues stricter effluent limitations for the City of Dawson sewage treatment plant.

1.3 EPA TOTAL SUSPENDED SOLIDS TMDL FINDINGS

The EPA TSS TMDL calculated that the ambient levels of TSS are ~107 mg/l and established a criteria that the waterbody should meet the instream target of 50 mg/l. Based on historical data, the TMDL reported that the Bayou Queue de Tortue will require a reduction of TSS loadings of anthropogenic sources by 53% in order to meet this instream target.

Constituent	LDEQ/EPA Standard	Percent Reduction	Nonpoint Sources of Pollutant
DO and Nutrients	5.0 mg/l Dec – Feb 3.0 mg/l March - Nov	60% 60%	Agriculture, Urban Runoff, Home Sewerage, Hydro-modification
TSS	50 mg/l	53%	Same as above
Turbidity	150 NTU	75% April 40% Feb, Mar, May	Same as above
TDS	260 mg/l	27%	Same as above

Table 1.1 The water quality standards and the TMDL required reductions are shown above for each constituent. Also, all the pollutants migrate to the waterway from the same sources during wet weather or during rice field discharges.

1.4 EPA Turbidity TMDL Findings

The EPA Turbidity TMDL involved examining ambient water quality data of turbidity samples and found that on average the turbidity guideline of 150 NTU is being maintained during the months of June-January. During the months of February, March, and May, the mean turbidity levels were 250 NTU and during the month of April the mean rose to 600 NTU. The spikes in turbidity coincide with the spring release of rice field discharges into the watershed. Therefore, the EPA ordered 2 restrictions for turbidity loading and only during the months of the rice-planting season. The months of February, March, and May will require a turbidity reduction of 40% and the month of April will require a 75% reduction in NPS loading. There are no turbidity restrictions during the months of June-January.

1.5 EPA Total Dissolved Solids TMDL Findings

The EPA TDS TMDL process also reviewed historical data and found the average levels of TDS in the bayou were 358 mg/l. Again the highest concentrations coincided with rice seeding and leveling during the spring planting months. The EPA did not segregate guidelines for the spring planting season but is recomending 27% reduction in TDS year round. The TMDL reports that rice fields are the major contributor to the NPS loading of TDS.

1.6 Similarities Between TMDL Constituents

The suite of constituents addressed in this Implementation Plan are intimately related in that TDS, TSS, and Turbidity are oxygen-demanding substances. The DO TMDL requires that sources of oxygen demanding substances be reduced by 60%. Land uses such as agriculture, urban, industry, and natural systems contribute to the loading of chemical, mineral, and biological elements to the waterways that both suppress DO and increase levels of TSS, TDS, and Turbidity. In other words, an Implementation Plan to reduce oxygen demanding substances from entering the waterway can also serve as an Implementation Plan to reduce materials that create turbid conditions in the waterway and increase levels of TDS and TSS.

1.7 Timeline for Implementation Plan

An Implementation Plan for the watershed restoration actions will be submitted to the EPA by the end of year 2002. This document will outline a 5-year management plan to reduce NPS pollutants from reaching the waterways. The LDEQ water quality team intensively samples each watershed in the state once every 5 years to see if the water bodies are meeting water quality standards. This 5 year cycle of water quality sampling began in 1998 in the Bayou Queue de Tortue and will occur again in 2003, 2008, and 2013. In 2003, LDEQ will sample the bayou to see if there has been any improvement since 1998. In 2008, LDEQ will sample again in the watershed to see if the waterway has improved as the result of BMPs recommended in the watershed Implementation Plan. If not, LDEQ will revise the Implementation Plan to include additional corrective actions to bring the waterway into compliance. Additional BMPs will be employed, if necessary, beginning in 2009 and increased until water quality standards are achieved by 2013. The long-term goal for restoring the waterway is 2015. The data from 2003 will be considered baseline from which to measure the rate of the water quality improvement in samples taken in subsequent years. The data collected in 2008 will be used to determine if the implementation of management measures in the Implementation Plan have been effective and corrective actions will be implemented until the water body meets criteria by the year 2015.

1.8 Description of Bayou Queue de Tortue Watershed

The Bayou Queue de Tortue (050501) watershed is a 305 sq mile area located in South Louisiana. Historically, the watershed encompassed a prairie region peppered with small clusters of hardwood forest. The bayou is comprised of the main stem and several tributaries. These include Indian Bayou, Prime Gully, Coulee des Iles/Bayou Grand Marais, Lyons Point Gully, Lazy Point Canal and many unnamed canals. The bayou is approximately 56 miles in length, including its diffuse network of headwaters, and flows through Acadia, Lafayette, and Vermillion Parishes. The main channel runs approximately 44 miles (71 km) from the City of Duson to The Mermentau River. Average precipitation in the watershed is 56.9 inches. The highest elevations are 25 feet mean sea level (msl) and the bayou's width generally increases as it progresses downstream. The bayou has been heavily hydromodified for approximately 30 miles in its middle reaches, while the upper and lower reaches are highly meandered, and both largely undisturbed swampy areas. This dredging has created square cross-sections and homogenized the streambed gradient, reducing the overall flow velocity and increasing the hydraulic retention time in the segment, especially upstream of LA Highway 13. These channelized portions have low reaeration potential and are depositional in nature. The eroding, unstable spoil banks have caused a large amount of clay fines to be suspended in the water column, resulting in increased turbidity in the bayou. Downstream of LA Highway 13 the stream is less disturbed. The banks are swampy and rooted macrophytes extend well into the waterway in some areas. The area acts as a large settling basin. The water here is less turbid and reddish brown in color due to humic acid input from the adjacent swampland.

Table 4.1 The Attainable and Designated Uses of the Bayou Queue de Tortue are the numerical criteria to insure Louisiana's waterways maintain safe levels for human health, propagation of fish and wildlife, and maintenance of recreational uses. As you can see from the table below, the Bayou Queue de Tortue is meeting criteria for primary and secondary recreation and not meeting the criteria for the propagation of fish and wildlife (DO, TDS, TSS, and Turbidity standards).

Use Attainability and Designated uses of the Bayou Queue de Tortue

Waterbody	NPS related parameters for which numerical standards have been developed	Standard (From LDEQ Environmental Regulatory Code)	Does waterbody meet standard? (From 2000 305(b) Report)	Constituents for which TMDLs will be developed (From 1998 Court Ordered 303(d) list) [3]
Bayou Queue de Tortue	Primary Contact Recreation	[1]	Fully	Lead, Mercury, Phosphorus, Nitrogen, Organic Enrichment/Low D.O., Pathogen Indicators, Turbidity, Suspended Solids, Salinity/TDS/Chlorides/Sulfates, Oil and Grease, Ammonia, Siltation
	Secondary Contact Recreation	[2]	Fully	
	Dissolved Oxygen	5 mg/l- 3mg/l	Not	
	Total Dissolved Solids	500 mg/l	Not	
	Temperature ºC	32	Fully	
	Turbidity	150	Not	
	Total Suspended Solids	260	Not	

[1] Based on a minimum of not less than five samples taken over not more than a 30-day period. Fecal coliform count should be less than 200 /100ml over a 30-day period, and less than 10 % of samples during any 30-day period or 25 % of total samples collected annually can exceed 400/100ml. Applies only May 1 – Oct. 31, otherwise, criteria for secondary contact recreation applies.

[2] Based on a minimum of not less than five samples taken over not more than a 30-day period Fecal coliform count should be less than 1000 /100ml in at least 5 samples taken over a 30-day period, and less than 10 % of samples during any 30-day period or 25 % of total samples collected annually can exceed 400/100ml.

[3] It should be noted that TMDL listings were based on information dating back to 1992. A waterbody may meet standards for a particular constituent in the 2000 305(b) Report, but may require a TMDL due to failure to meet standards in a previous year. In addition, a waterbody may be listed due to its failure to meet certain narrative criteria.

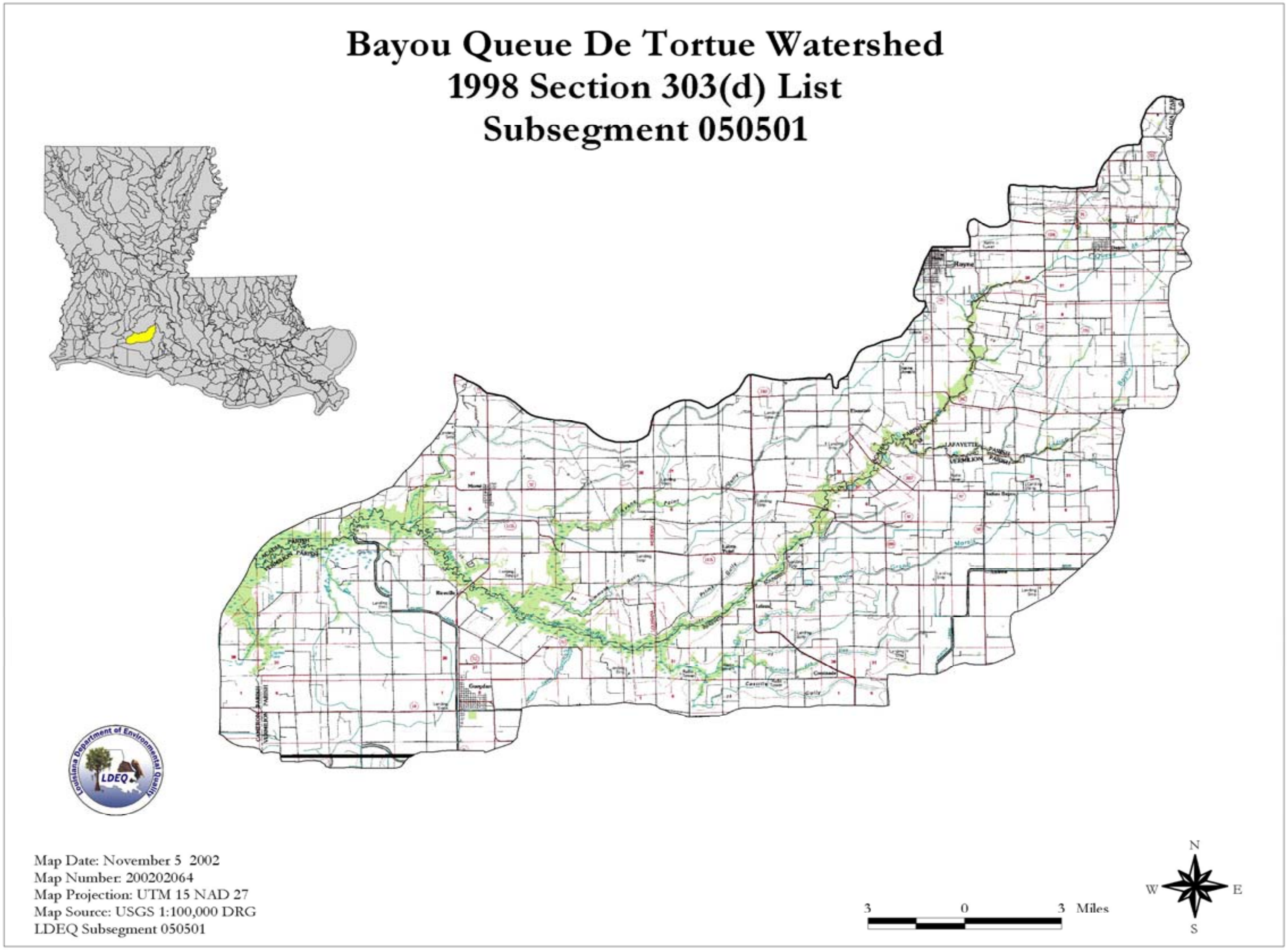


FIGURE 1.1 Bayou Queue de Tortue watershed is located in Southern Louisiana and is primarily composed of agricultural lands of which rice, soybeans, crawfish, and pasturelands constitute the majority of crops raised in the area.

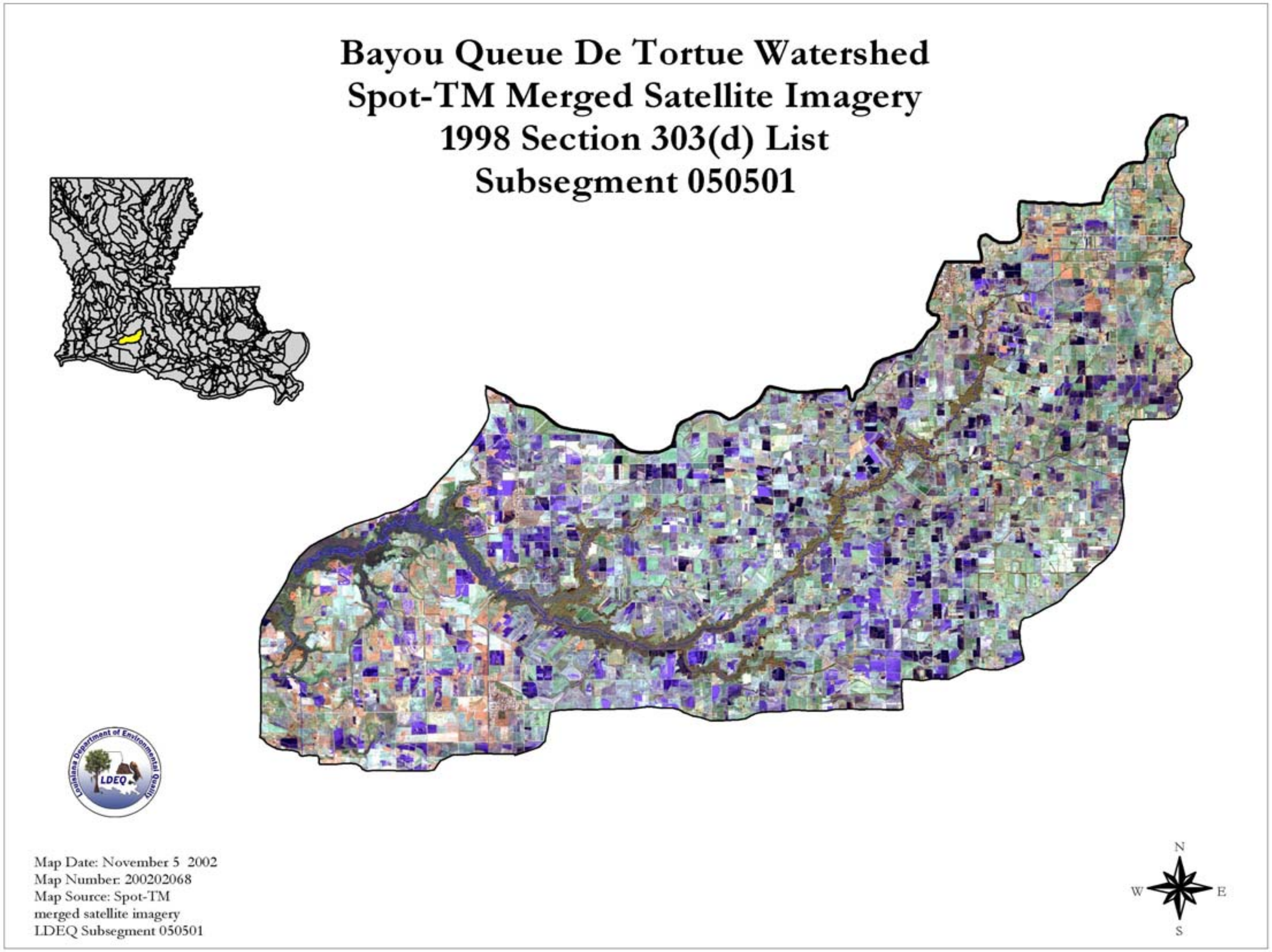


FIGURE 1.2 Spot-TM Satellite imagery of the Bayou Queue de Tortue. The blue areas on the image are rice fields.

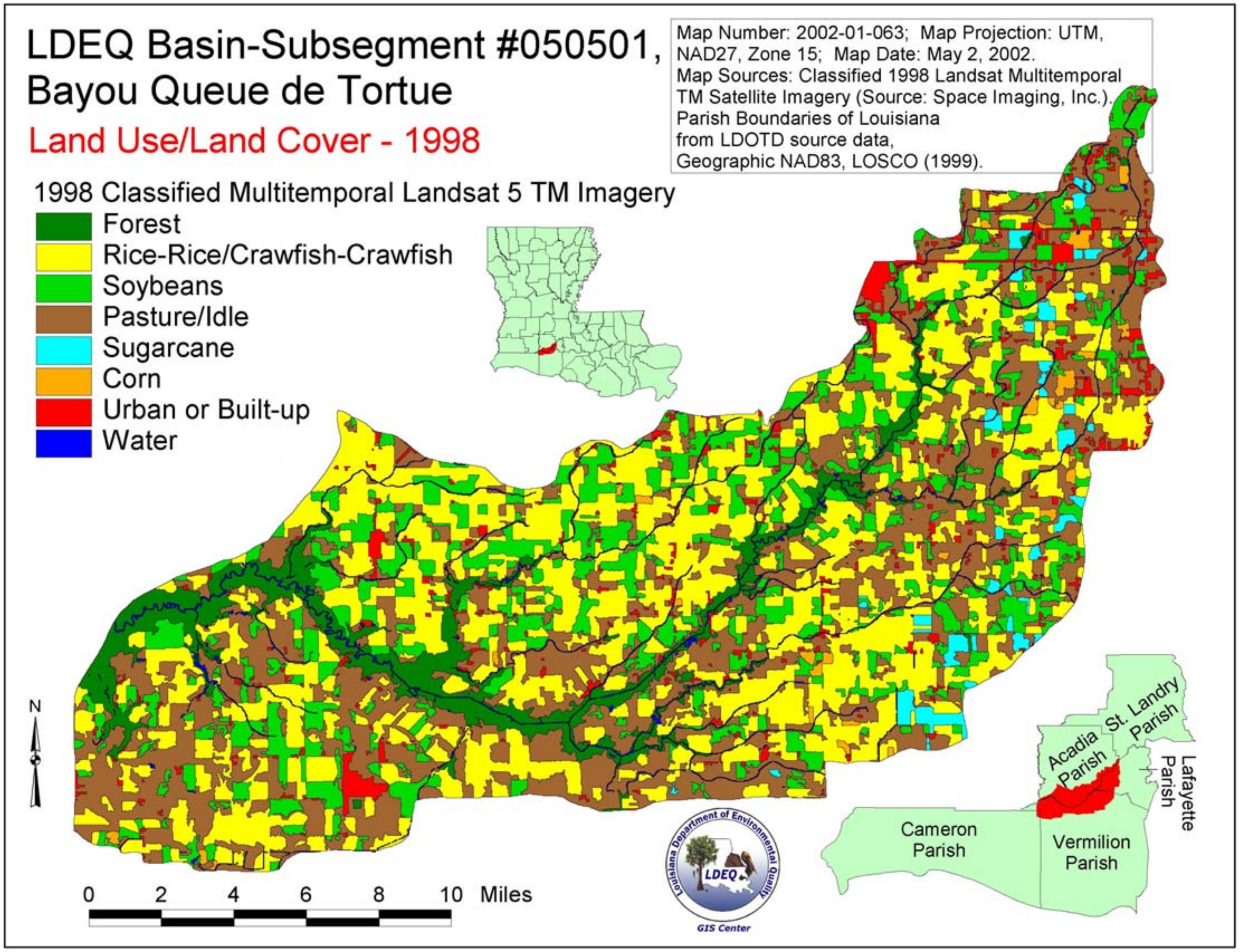


Figure 1.3 Landuse map of Bayou Queue de Tortue. Pasture, rice, and soybeans are the predominant landuse in the watershed. Rice and soybeans rotate in the same fields every other year.

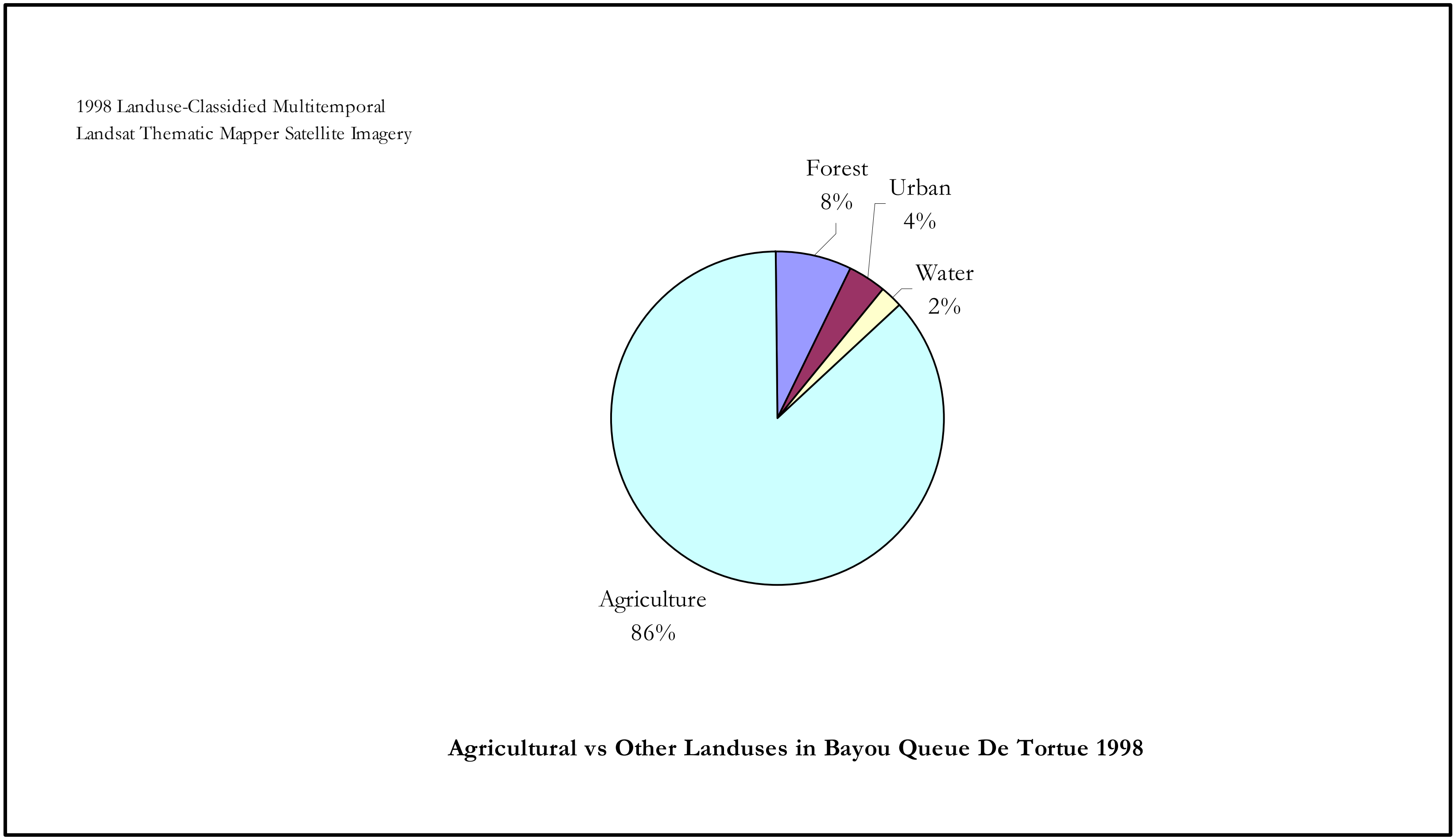


Figure 1.4 Agricultural practices compose 86% of the landuses in the Bayou Queue de Tortue watershed.

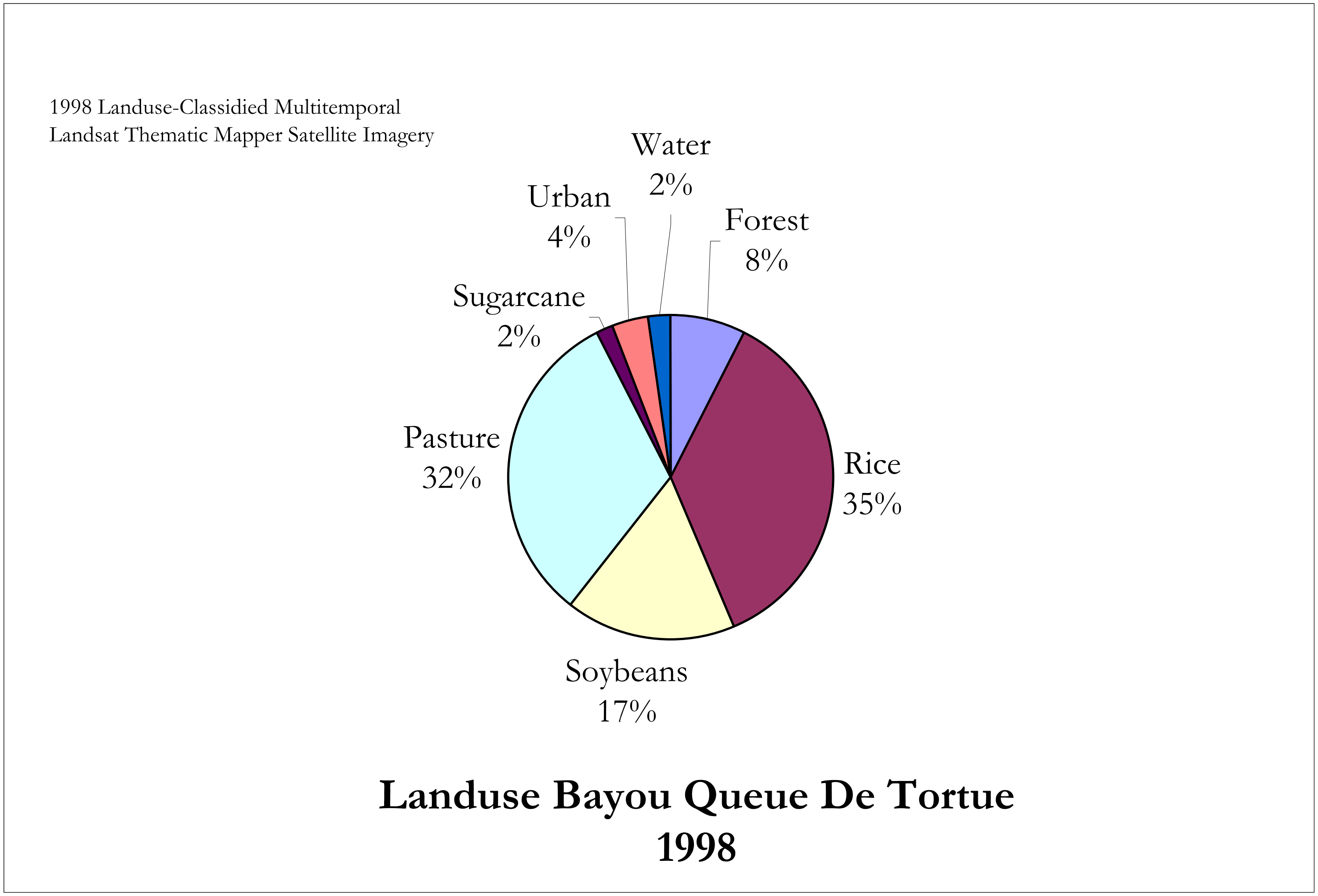


Figure 1.5 Agricultural practices are almost equally divided between rice, soybeans, and pasture. Rice and soybeans are commonly rotated with each other in the fields in the lower SE sector of the watershed.

2.0 Historical Environmental Water Quality Monitoring in the Bayou Queue de Tortue

2.1 Introduction

In order to demonstrate historical trends in NPS pollution, results from 20 years of water quality sampling are presented below. The data was collected at sampling station 58010046 located 3.3 miles north of Gueydan, Louisiana where LA Highway 91 crosses Queue de Tortue. The data is also for reference, for comparison with results of future water quality monitoring data.

2.2 Seasonal Spikes in Pollutants Coincide with Rice Field Leveling and Planting

The water quality data clearly demonstrates that runoff of the majority of oxygen demanding substances coincides with the spring release of impounded water from rice fields. Rice farmers flood the fields in the spring to level the field "mudding in" and plant the rice seed. Once the field is leveled and planted, the impounded water is released from the field and after a couple of weeks, the field refilled again. Mudding in a rice field involves flooding the field and running disks through the mud and water. Presumably, the disk leveling evens out the high spots and the suspended solids fill in the low spots. Discharges of suspended solids are magnitudes greater during this spring discharge event over the drainages for pesticide/fertilizer applications and harvest that occur during the summer and fall seasons. Root matter anchor sediments in the field, and foliage rising through the impounded water provide surface area for microbial decomposition of organic materials and nitrogenous compounds. The summer and fall discharges are relatively clean outflows with very little of the sediments leaving the field.

2.3 Temperature is Inversely Proportional to Dissolved Oxygen

Another clear trend in the historical results is the relationship of DO levels to temperature. Biochemical reactions, in general, follow the van't Hoff rule of a doubling of the reaction rate for a 10^{o}C increase in temperature over a restricted temperature range. Therefore, temperature is strongly inversely proportional to dissolved oxygen levels. July and August are the hottest months in Louisiana, while October and November are the months with lowest stream flows. Dissolved oxygen and runoff are moderately directly proportional. The TMDL analysis concluded that critical conditions for stream DO concentrations were those of negligible nonpoint run-off and low stream flow combined with high stream temperature. When the rainfall and stream flow are high, turbulence is higher due to higher flow and the temperature is lowered due to rainfall run-off. Reaeration rates are much higher when water temperatures are cooler and BOD decay rates are much lower. For these reasons, periods of high loadings are periods of higher reaeration and DO but not necessarily periods of high BOD decay. LDEQ interprets this phenomenon in its TMDL modeling by assuming that the annual nonpoint loading, rather than loading for any particular day, is responsible for accumulated benthic blanket in the stream, which is expressed as SOD or re-suspended BOD. This accumulated loading (SOD) has its greatest impact on the stream during periods of higher temperature and lower flow.

2.4 HISTORICAL DATA DISCUSSION

The two clearest trends in the historical data are the presence of pollutants in the waterway from the spring discharge from rice fields and the inverses relationship between temperature and DO. As mentioned, the low DO conditions occur in September and October when temperature are high and flow is low. The pollutants that have entered and settled in the stream earlier in the year begin to re-suspend and exert a Sediment Oxygen Demand (SOD) in the waterway. The majority of these benthic materials arrive during the spring planting season of rice and remain in the waterway until they are flushed out from a major storm event. The establishment of riparian areas and the growth of native trees along stream banks provide shade along the stream network and food to numerous organisms. The growth of willows and other indigenous shore trees are proven methods for keeping water temperatures several degrees cooler than areas exposed to the sun.

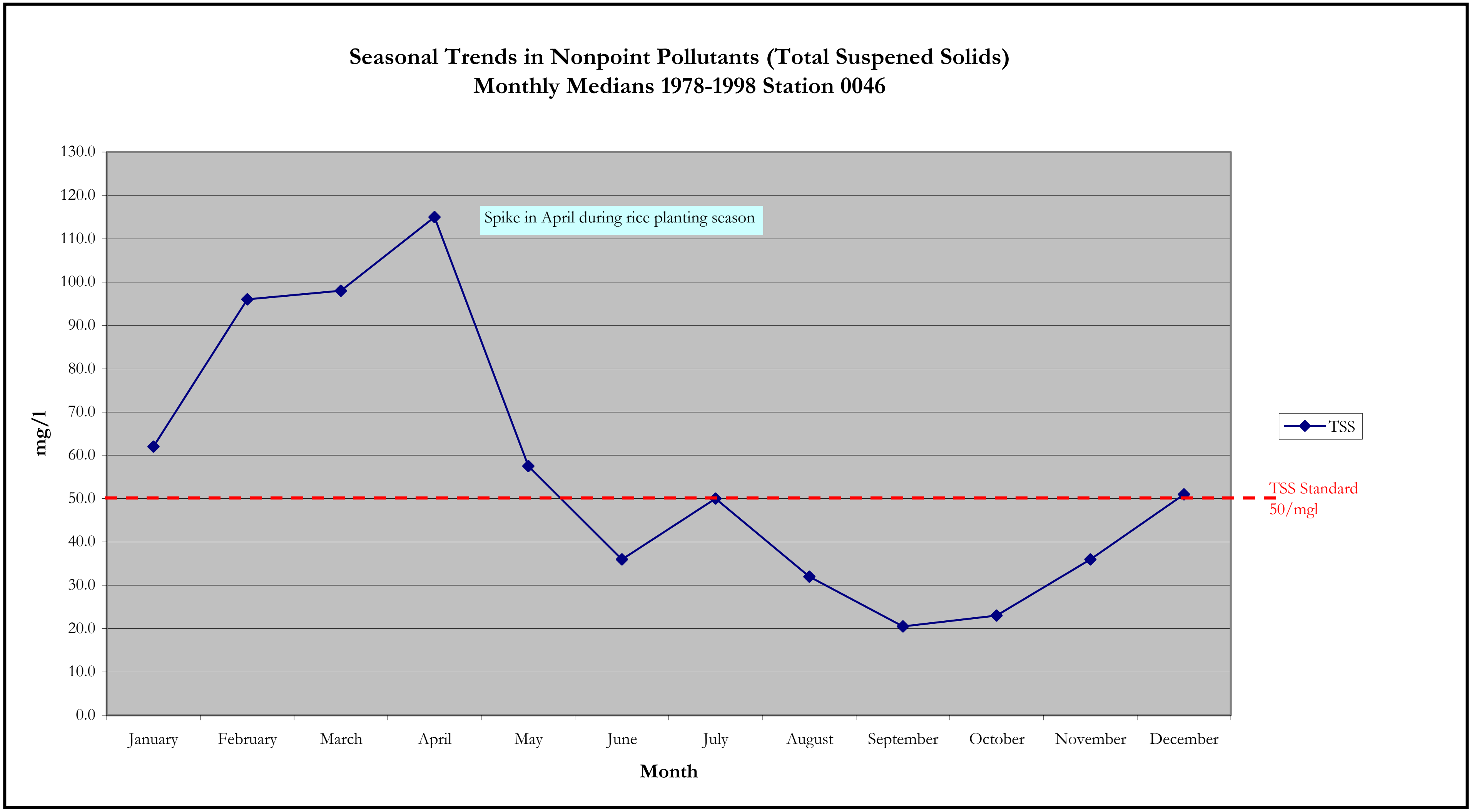

Seasonal Trends in Nonpoint Pollutants (Total Suspened Solids)
Monthly Medians 1978-1998 Station 0046
Spike in April during rice planting season
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
mg/l
January
February
March
April
May
June
July
August
September
October
November
December
Month
TSS
TSS Standard
50/mgl

Figure 2.1

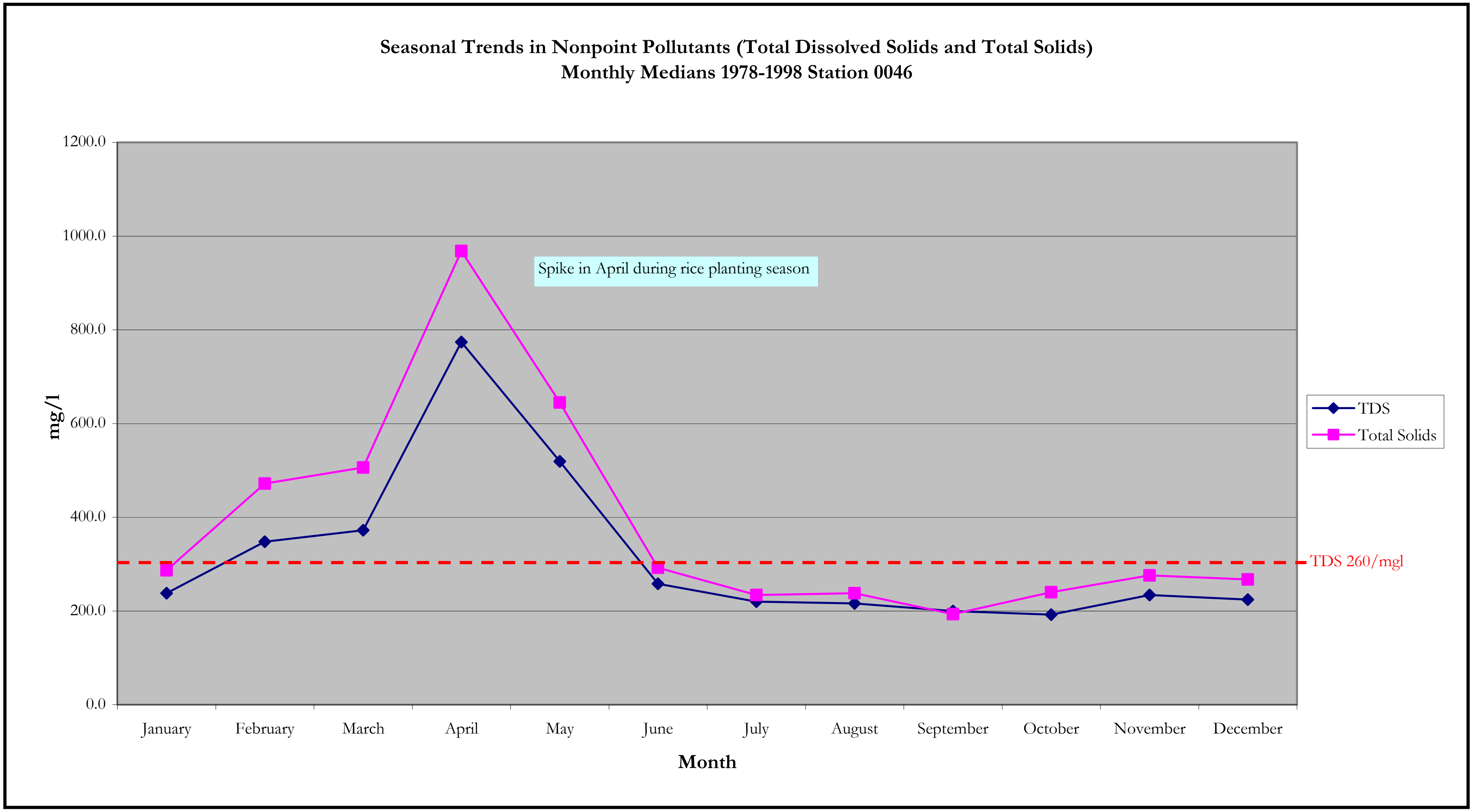

Seasonal Trends in Nonpoint Pollutants (Total Dissolved Solids and Total Solids)
Monthly Medians 1978-1998 Station 0046
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
mg/l
Spike in April during rice planting season
TDS 260/mgl
TDS
Total Solids
January
February
March
April
May
June
July
August
September
October
November
December
Month

Figure 2.2

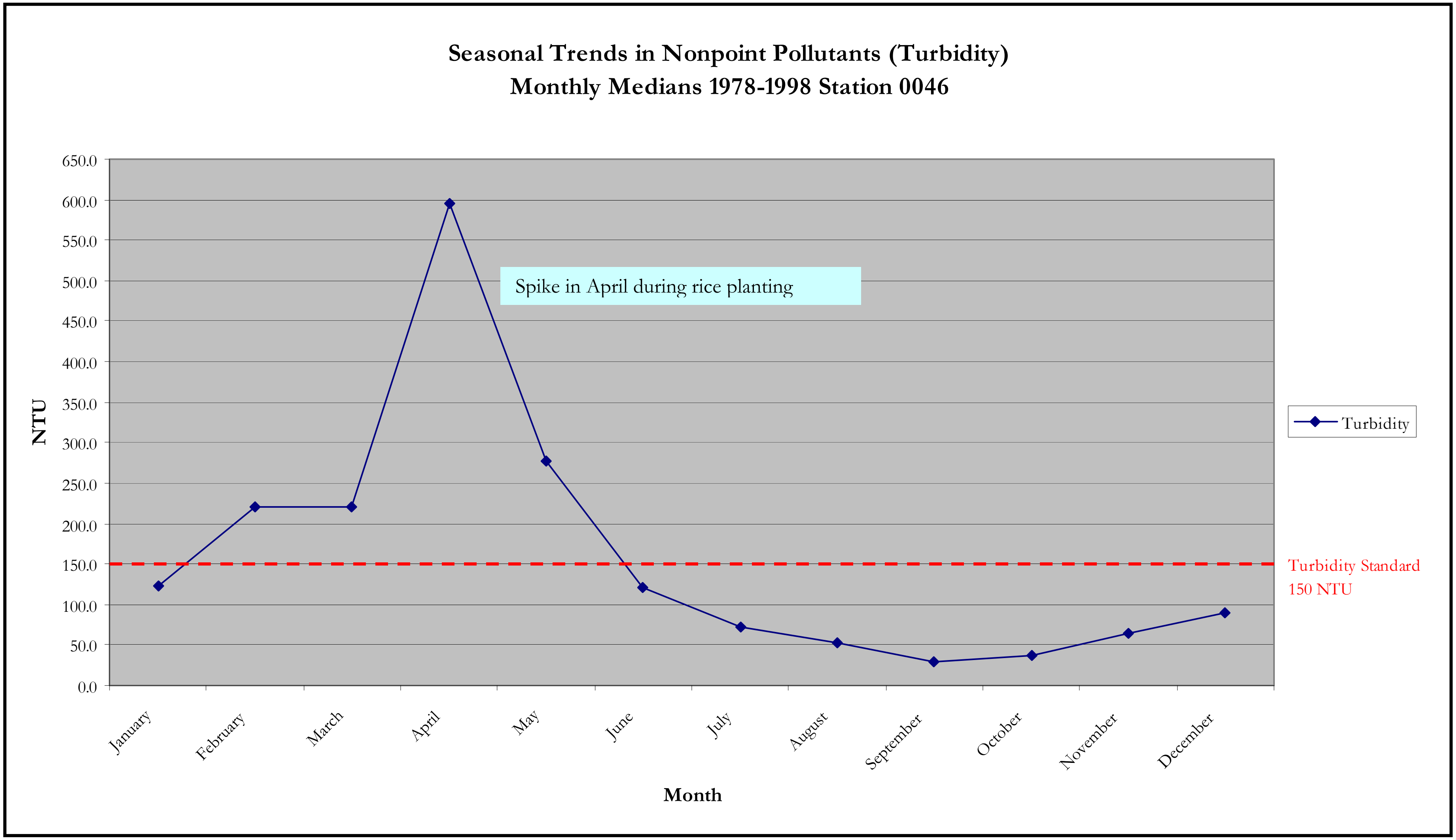

Seasonal Trends in Nonpoint Pollutants (Turbidity)
Monthly Medians 1978-1998 Station 0046
NTU
650.0
600.0
550.0
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Spike in April during rice planting
Turbidity
Turbidity Standard
150 NTU
January
February
March
April
May
June
July
August
September
October
November
December
Month

Figure 2.3

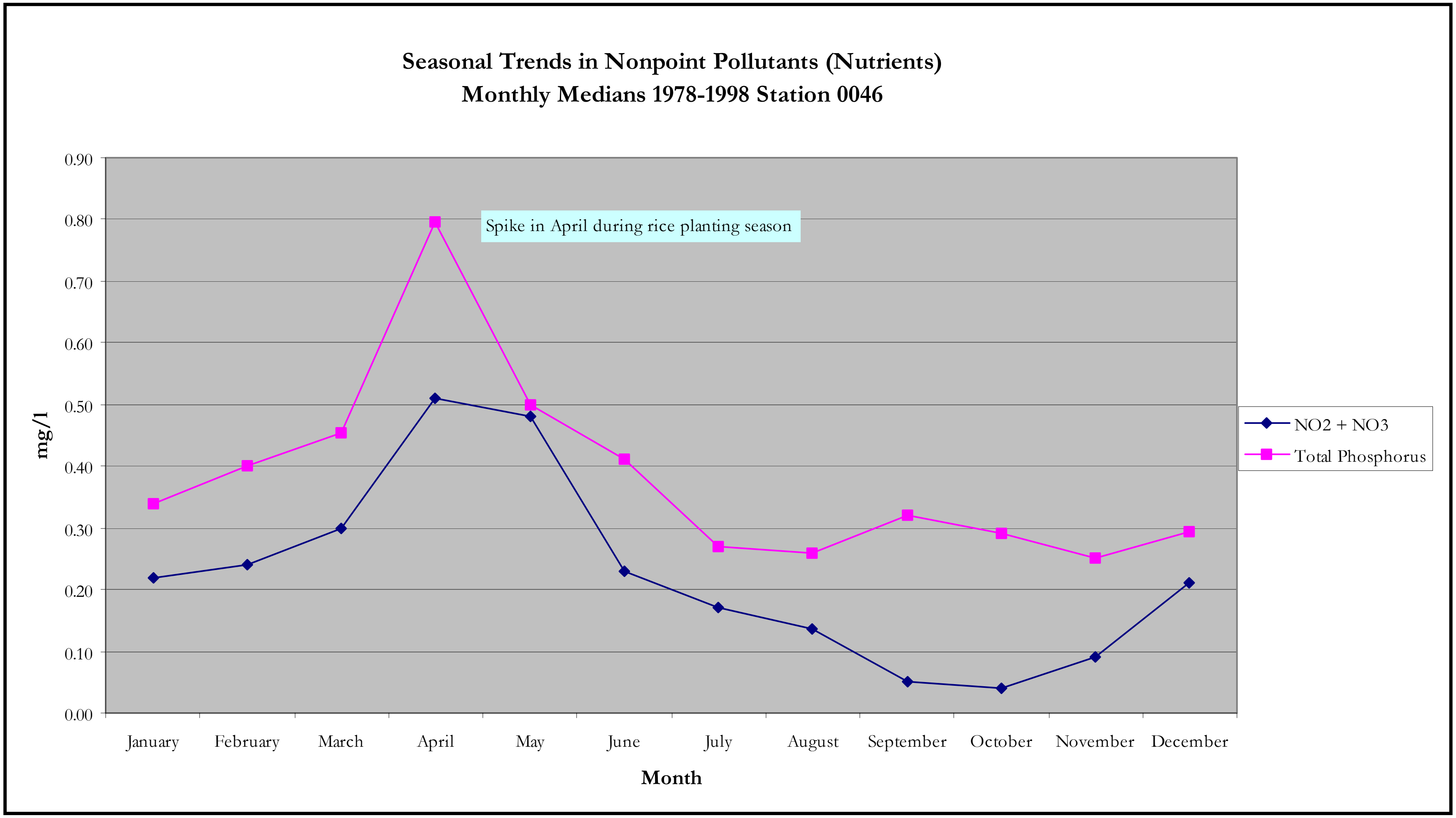

Seasonal Trends in Nonpoint Pollutants (Nutrients)
Monthly Medians 1978-1998 Station 0046
Spike in April during rice planting season
mg/l
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
January
February
March
April
May
June
July
August
September
October
November
December
Month
NO2 + NO3
Total Phosphorus

Figure 2.4

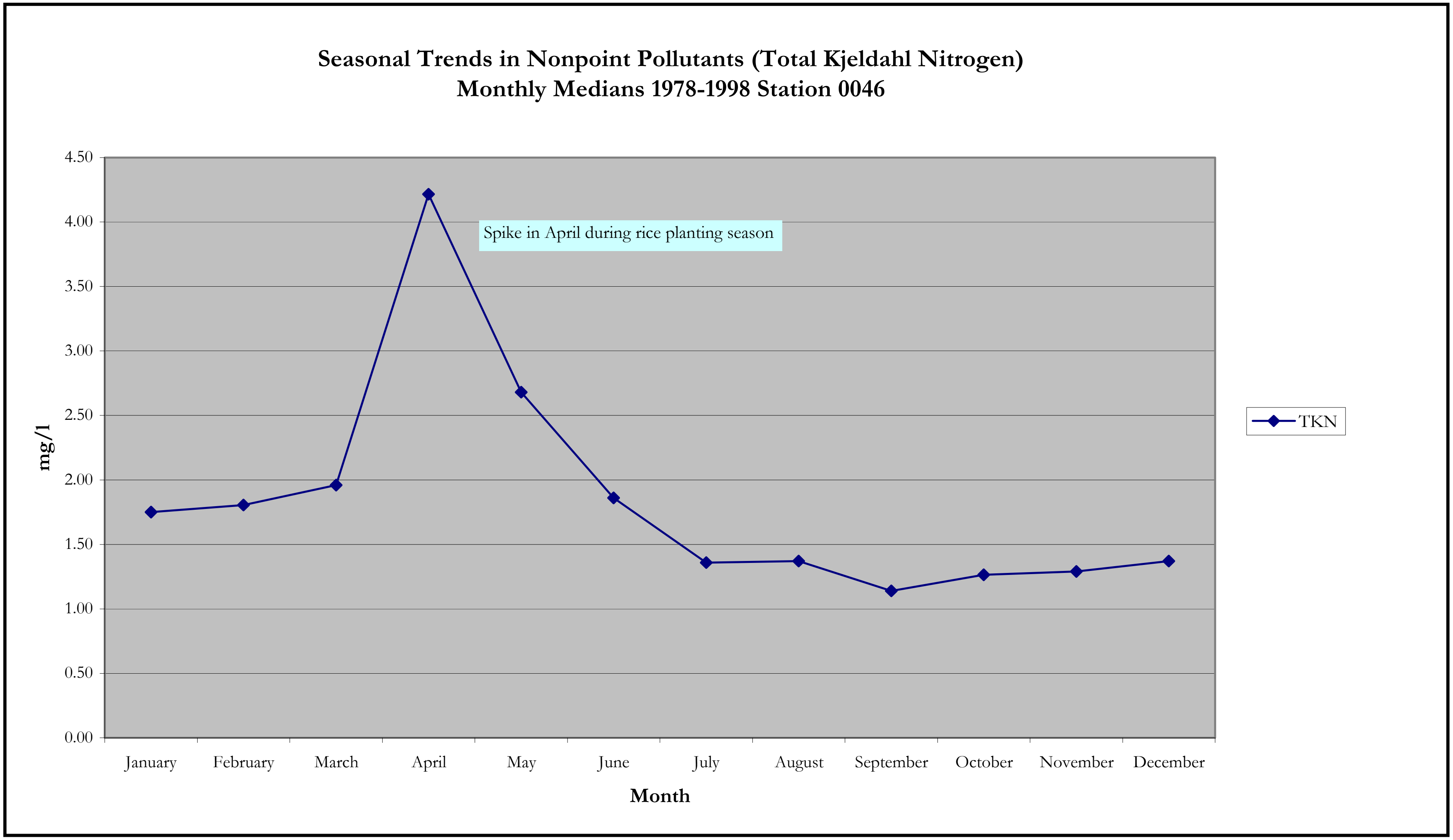

Seasonal Trends in Nonpoint Pollutants (Total Kjeldahl Nitrogen)
Monthly Medians 1978-1998 Station 0046
Spike in April during rice planting season
mg/l
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
January
February
March
April
May
June
July
August
September
October
November
December
Month
TKN

Figure 2.6

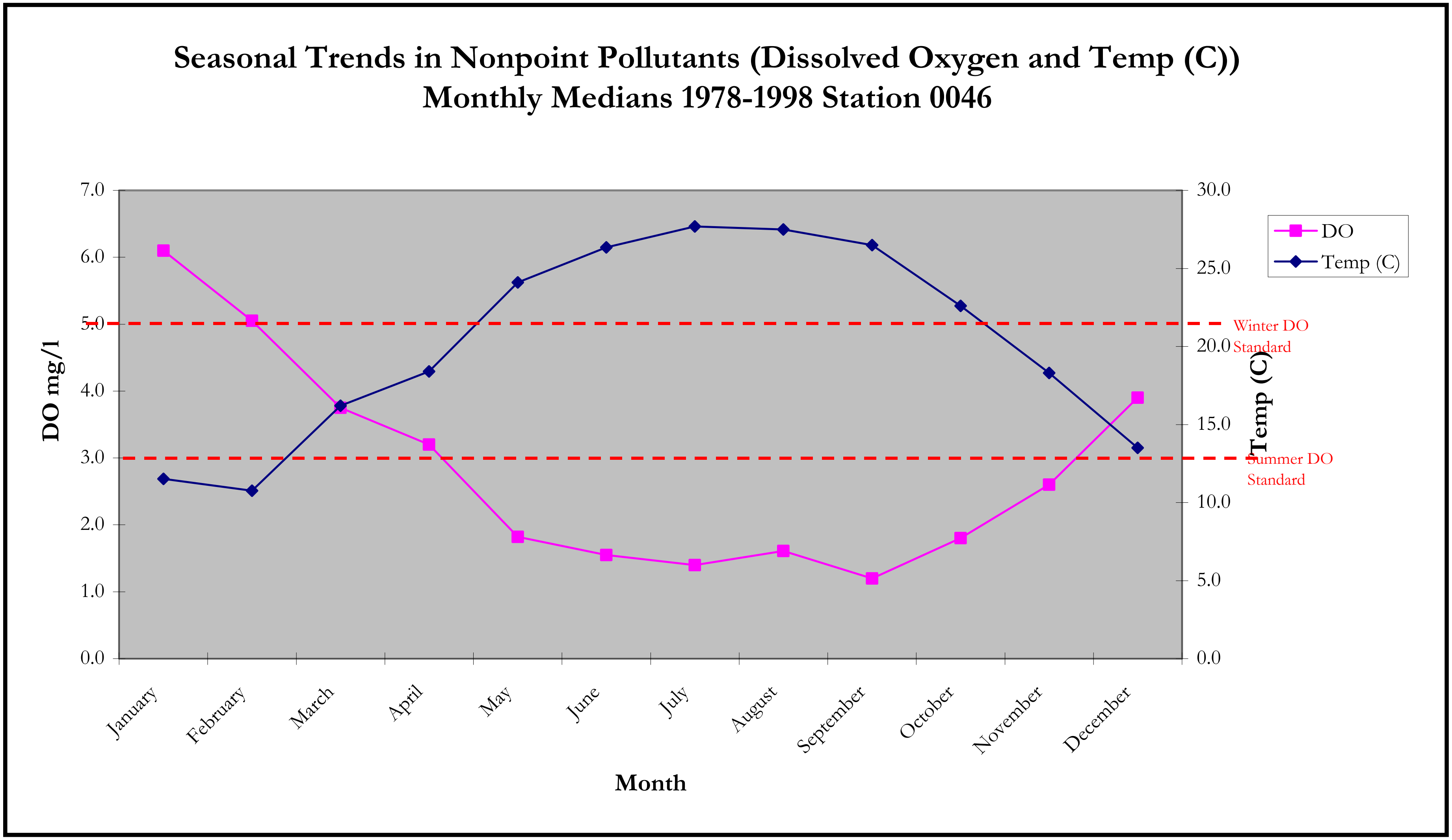
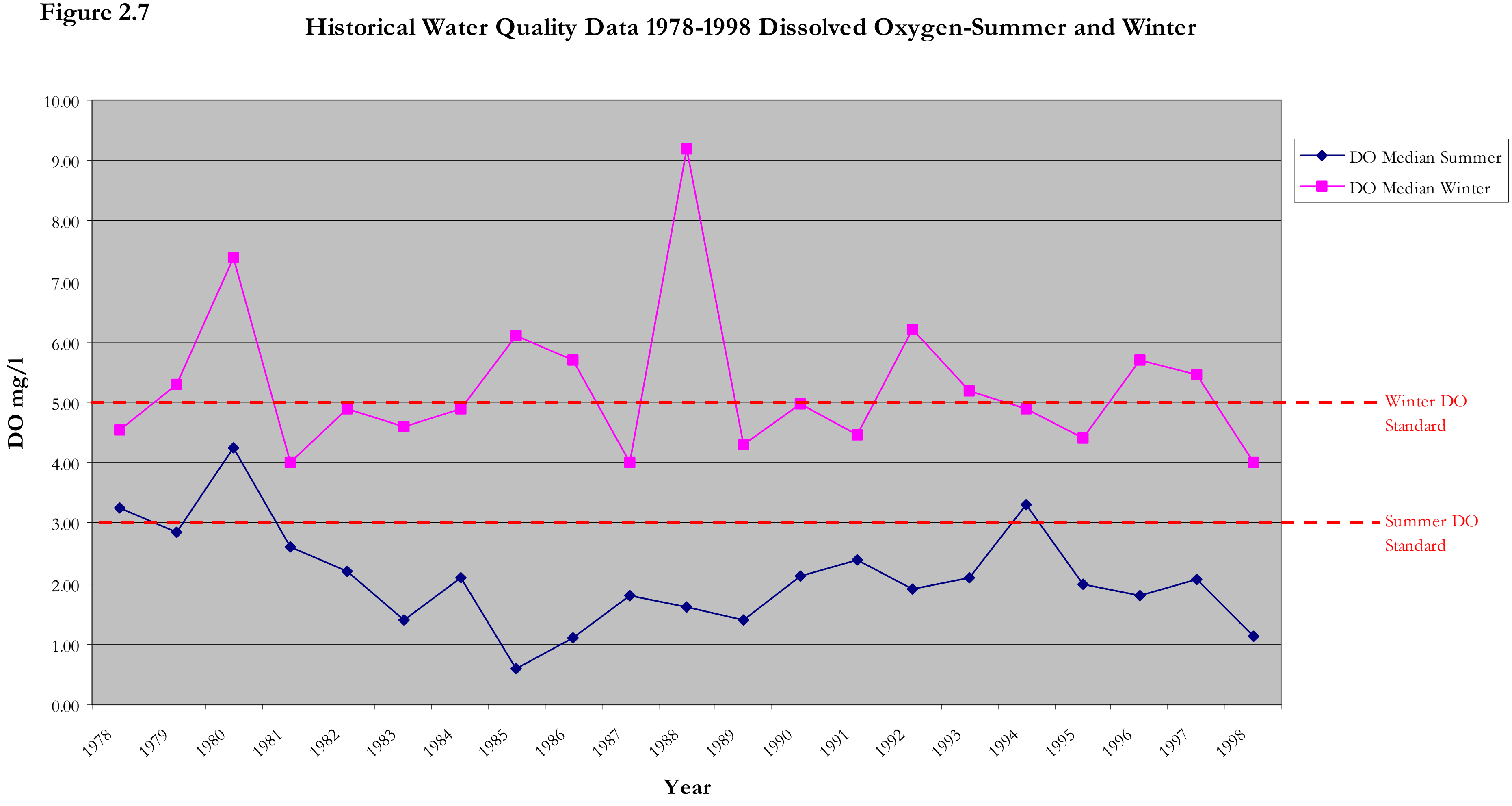

Seasonal Trends in Nonpoint Pollutants (Dissolved Oxygen and Temp (C))
Monthly Medians 1978-1998 Station 0046
DO mg/l
Temp (C)
Month
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
January
February
March
April
May
June
July
August
September
October
November
December
DO
Temp (C)
Winter DO Standard
Summer DO Standard

Figure 2.7


Historical Water Quality Data 1978-1998 Dissolved Oxygen-Summer and Winter
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
DO mg/1
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year
DO Median Summer
DO Median Winter
Winter DO Standard
Summer DO Standard

Annual Medians from1978-1998 Water Quality Survey at Bayou Queue de Tortue Station: 0046

YEAR	Temperature Centigrade	Dissolved oxygen (mg/L)	Total dissolved solids (mg/L)	Total suspended solids (mg/L)	Turbidity NTU	Total Solids (mg/l)	NO2 Nitrate (mg/L)	Total Kjeldahl nitrogen (mg/L)	Total Phosphorus (mg/L)	Total organic carbon (mg/L)
1978	23.75	3.40	209.00	46.00	60.00	264.00	0.56	2.14	0.48	12.50
1979	22.00	4.20	178.00		86.00		0.19	1.73	0.37	6.75
1980	16.00	4.50	348.00	254.00	126.50	461.00	0.22	2.40	0.47	6.75
1981	22.75	2.95	210.00	73.00	82.50	274.00	0.27	1.73	0.33	9.50
1982	19.35	2.55	230.00	44.00	68.50	280.00	0.13	1.55	0.34	11.00
1983	19.15	2.00	176.00	60.00	127.50	266.00	0.15	1.23	0.34	8.70
1984	20.70	2.15	220.00	44.00	168.00	251.00	0.19	1.38	0.37	12.45
1985	23.35	1.45	267.00	23.00	151.50	304.00	0.17	1.67	0.38	14.10
1986	22.20	1.20	234.00	28.00	68.00	266.00	0.16	1.66	0.44	14.70
1987	20.30	2.00	279.00	49.00	75.50	327.00	0.16	2.31	0.49	14.70
1988	20.85	2.20	230.00	54.00	102.50	310.00	0.26	1.71	0.34	13.00
1989	20.50	1.40	258.00	32.00	85.00	288.00	0.22	1.62	0.34	12.60
1990	20.33	2.56	272.00	44.00	105.00	314.00	0.20	1.40	0.32	12.15
1991	22.35	2.70	217.00	44.00	102.50		0.15	1.46	0.35	11.55
1992	20.40	2.10	288.00	55.50	140.00		0.17	1.79	0.31	15.20
1993	20.85	3.70	236.00	47.00	115.00		0.22	1.27	0.28	10.30
1994	21.29	3.50	246.00	63.00	121.00		0.20	1.48	0.35	10.40
1995	18.90	2.50	323.00	75.00	87.50		0.19	1.71	0.33	10.20
1996	19.35	2.15	259.00	68.00	119.00		0.21	1.34	0.38	12.70
1997	20.05	2.51	322.00	33.00	140.00		0.16	1.74	0.26	10.20
1998	24.48	1.22	394.00	23.00	65.00		0.10	1.32	0.31	10.95
20 yr avg	**20.90**	**2.52**	**256.95**	**57.98**	**104.60**	**300.42**	**0.20**	**1.65**	**0.4**	**11.4**
Criteria	3mg/l summer 5mg/l winter	260 mg/l	NA		Naturally occurring range [1]		NA	150 NTU	200 cfu primary 1000 cfu secondary	

[1] The naturally occurring range of nitrogen-phosphorus ratios shall be maintained. Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated uses shall not be added to any surface waters. LAC 33:IX.1113.8

Table 2.1

Monthly Medians from 1978-1998 for Water Quality Survey at Bayou Queue de Tortue Station:0046

Month	Temperature	Dissolved oxygen	Total dissolved solids	Total suspended solids	Turbidity	Total Solids	NO2 Nitrate	Total Kjeldahl nitrogen	Total Phosphorus	Total organic carbon
	Centigrade	(mg/L)	(mg/L)	(mg/L)	NTU	(mg/l)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
January	11.5	6.1	238.0	62.0	122.0	287.0	0.22	1.75	0.34	11.6
February	10.8	5.1	348.0	96.0	220.0	472.0	0.24	1.81	0.40	10.3
March	16.2	3.8	372.0	98.0	220.0	506.0	0.30	1.96	0.46	14.1
April	18.4	3.2	774.0	115.0	596.0	968.0	0.51	4.22	0.80	16.5
May	24.1	1.8	519.0	57.5	276.5	645.0	0.48	2.68	0.50	14.3
June	26.4	1.6	258.0	36.0	121.5	292.0	0.23	1.86	0.41	11.6
July	27.7	1.4	220.0	50.0	72.5	234.0	0.2	1.4	0.3	9.2
August	27.5	1.6	216.0	32.0	52.0	238.0	0.14	1.37	0.26	8.9
September	26.5	1.2	200.0	20.5	29.0	193.0	0.05	1.14	0.32	11.5
October	22.6	1.8	192.0	23.0	37.0	240.0	0.04	1.27	0.29	11.0
November	18.3	2.6	234.0	36.0	65.0	276.0	0.09	1.29	0.25	11.5
December	13.5	3.9	224.0	51.0	90.0	267.0	0.21	1.37	0.30	13.1
Criteria		3mg/l summer 5mg/l winter	260 mg/l	NA	150 NTU		Naturally occurring range [1]			NA

[1] The naturally occurring range of nitrogen-phosphorus ratios shall be maintained. Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated uses shall not be added to any surface waters. LAC 33:IX.1113.8

Table 2.2

3.0 Basin and Eco-region

3.1 Mermentau Rive Basin

The Mermentau River Basin was historically within the Mississippi and Red River drainage systems in an earlier geological time. However, today it is separate from these systems and is situated in the prairie region of southwestern Louisiana. Flood plains in the Mermentau River Basin average only about 5 feet above sea level, but range from 1 to 2 feet above mean sea level (msl) in the southern marshes to about 100 feet msl in the headwater area of Bayou Nezpique. Slopes average approximately 2 feet per mile. The streams of the Mermentau River flow through three distinct physiographic regions that are arranged in broad bands from north to south. The northern part of the basin is in flatwoods and an undulating landscape extends northward to the Calcasieu and the Red River drainage basins. To the south of the flatwoods region lies a broad prairie extending from the Vermilion River and Bayou Teche in the east to the Calcasieu Basin in the west. The prairie gives way to marshlands along the coast. The marsh is further subdivided into a freshwater marsh in the north which gradually becomes more saline as you approach the open Gulf.

At the time of settlement in the late 1700's, the predominant vegetation in the area consisted of grasses. Forests were confined to the marginal slopes of streams and the flood plains. The narrow upland forested riparian zones consisted of oak, gum, hickory, and pine trees, and the lower riparian flood plains were forested in oak, tupelo gum, and cypress. This area is subject to backwater flooding along waterways as a result of the low relief and flat contour of the land. Also, due to the low relief, flows in the bayous of this region are very slow, and reaeration rates are low. The flatness of the land in this region also makes it ideal for rice cultivation, which is the predominant land use in the area. Ninety-two percent of the land within the Mermentau River Basin is used for agriculture, with rice being the predominant crop.

The geology of the region is primarily sediments accumulated in the modern Mississippi River Delta, the flanking Chenier Plain and in older Pleistocene Age fluvial and deltaic depositional systems. Sediment types range from sand to mud. Shell and organic debris including peat are lesser constituents.

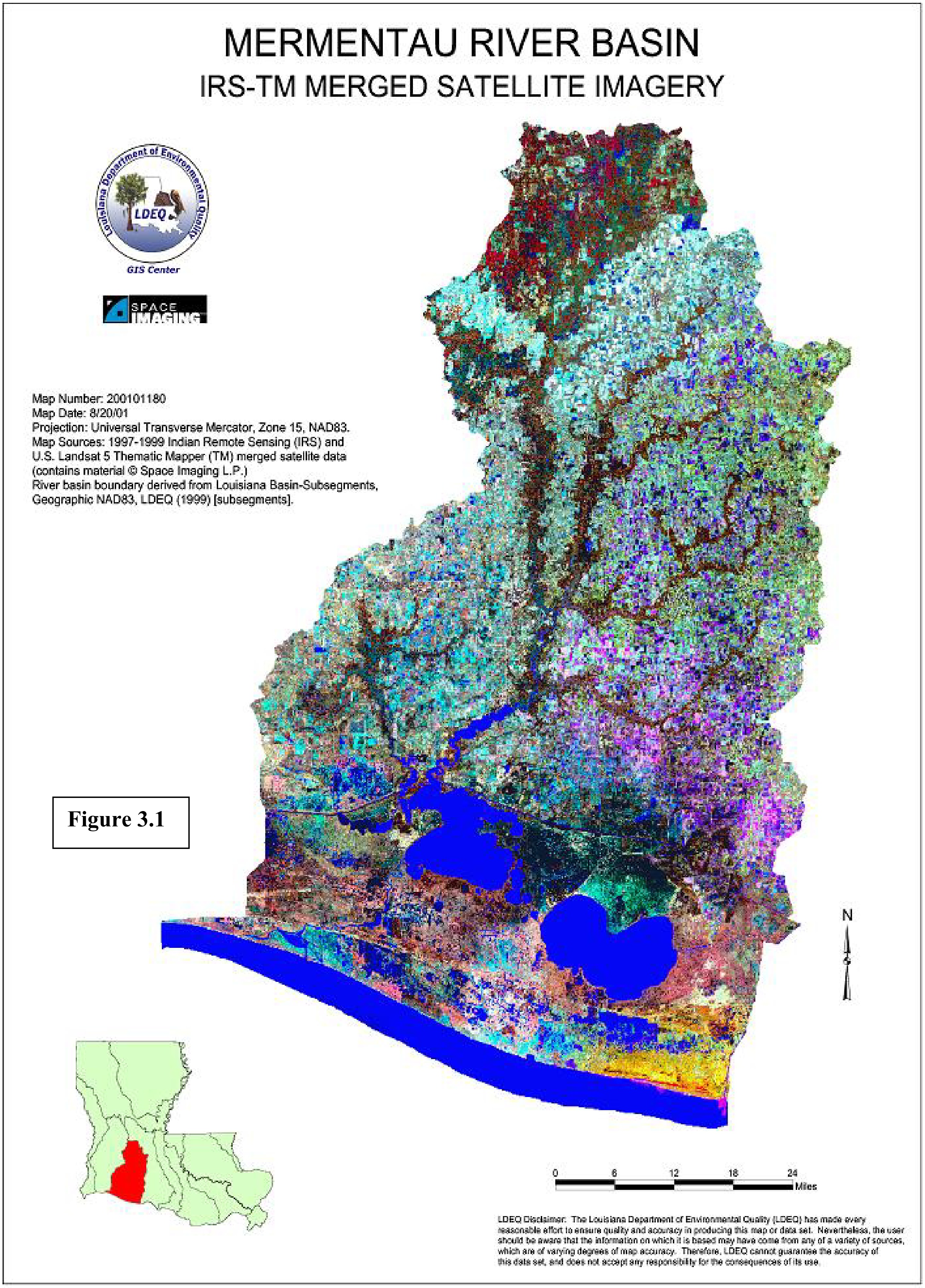

MERMENTAU RIVER BASIN
IRS-TM MERGED SATELLITE IMAGERY
Louisiana Department of Environmental Quality
LDEQ
GIS Center
SPACE IMAGING
Map Number: 200101180
Map Date: 8/20/01
Projection: Universal Transverse Mercator, Zone 15, NAD83.
Map Sources: 1997-1999 Indian Remote Sensing (IRS) and
U.S. Landsat 5 Thematic Mapper (TM) merged satellite data
(contains material © Space Imaging L.P.)
River basin boundary derived from Louisiana Basin-Subsegments,
Geographic NAD83, LDEQ (1999) [subsegments].
N
0 6 12 18 24
Miles
LDEQ Disclaimer: The Louisiana Department of Environmental Quality (LDEQ) has made every reasonable effort to ensure quality and accuracy in producing this map or data set. Nevertheless, the user should be aware that the information on which it is based may have come from any of a variety of sources, which are of varying degrees of map accuracy. Therefore, LDEQ cannot guarantee the accuracy of this data set, and does not accept any responsibility for the consequences of its use.

Figure 3.1

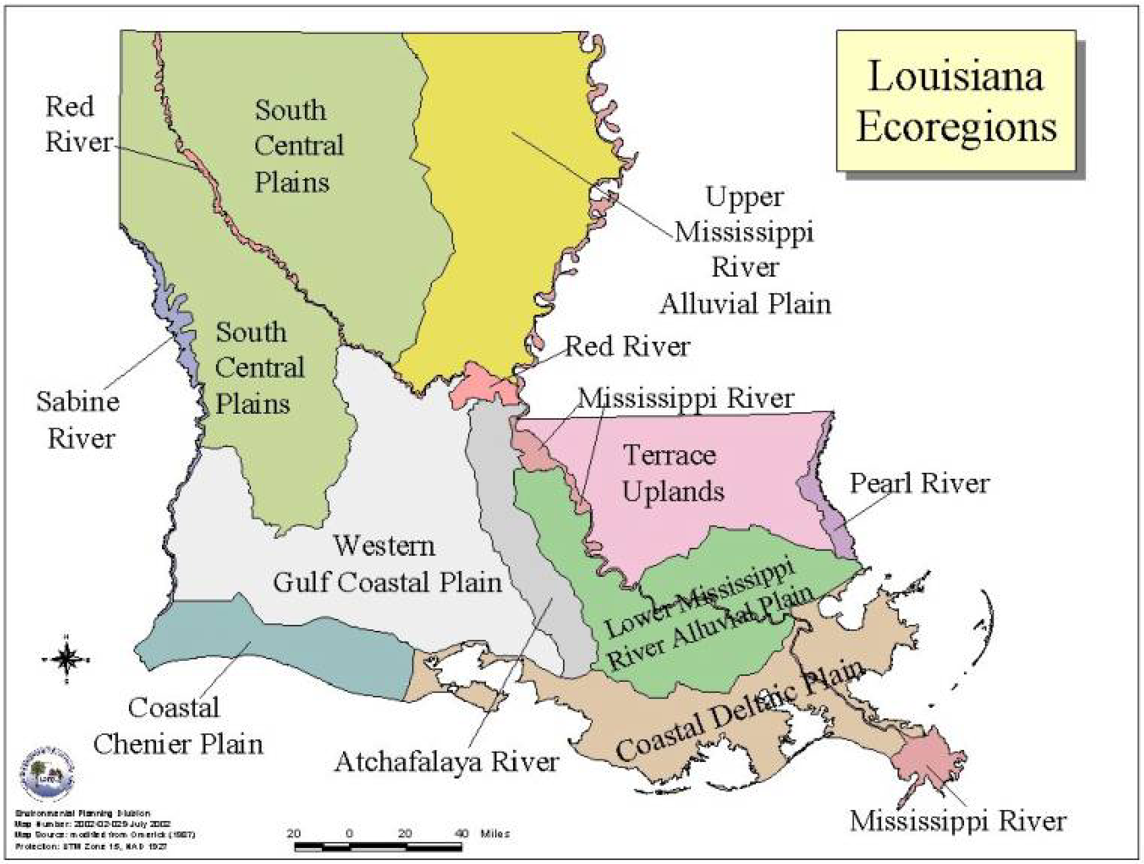


Figure 3.2 The State of Louisiana is divided into 12 Eco-Regions characterized by unique soils, fauna, and agricultural crops. The Bayou Queue de Tortue is located in the Western Gulf Coastal Plains.

3.2 DESCRIPTION OF LOUISIANA ECO-REGIONS

Bayou Queue de Tortue is located within Western Gulf Coastal Plain Ecoregion (WGCPE) in Southwest Louisiana. The WGCPE is bounded to the north by the South Central Plains Ecoregion, to the south by the Intracoastal Waterway, to the west by the Sabine River, and to the east by the Atchafalaya River. The ecoregion includes portions of the Sabine, Calcasieu, Mermentau, and Vermilion basins. Drainage basin boundaries and downstream estuarine waters isolate the four major river systems within the ecoregion. The ecoregion lies above tidal areas, except under extreme drought conditions; therefore, tidal influences areas aregenerally excluded. Although there are several types of vegetation present in the northern area of the ecoregion, 60 – 70% of the WGCPE has historically been a seasonally wet prairie. The prairie was maintained as a mosaic of treeless plains and tree lined river corridors by the presence of an impermeable, calcareous clay layer that prevented downward percolation or upward capillary action of water into the shallow soils. Disjunction of this clay layer at stream margins allows trees to grow for a few hundred feet on either side of the stream. This clay layer allows water to stand during wet seasons, supporting the dominant land use of the area, rice cultivation.

4.0 Nonpoint Source (NPS) Loadings into the Queue de Tortue Waterways

4.1 Introduction

Land uses such as agriculture, urban, industry, and natural systems contribute to the loading of chemical, mineral, and biological elements to the waterways. Hydromodification affects the transport of water through the stream networks and often reduces the capacity of riparian zones to retain sediments on stream bank. Residential home sewage from faulty septic systems also contributes to the nutrient and organic loadings to the waterways. As shown in the table below, NPS pollutant loadings to the Bayou Queue de Tortue are the result of three main sources: agriculture, urban, and natural background. There is no forestry and very little area used for oil production (extractive) in the watershed; however, the majority of the land is used for agriculture. Following up second is urban and/or rural residential. Discussed below are the suspect sources that contribute oxygen-demanding substances to the Queue de Tortue and its tributaries.

4.2 Agriculture

The primary agricultural crops in the Bayou Queue de Tortue watershed consist of rice, soybeans, a few fields of sugarcane, and grazing pasture, and there is some aquaculture in the form of crawfish farming during the winter months. Rain events suspend sediments, fertilizers, and pesticides and transport the agriculture runoff to the reaches of the bayou. Runoff from fields soon after tillage operations, fertilizer applications, and other field operations contains greater levels of sediments and pollutants. During the late winter and early spring, large volumes of very turbid water have been observed flowing downstream in the waterways, and this has been associated with planting activities in adjacent rice fields. The cumulative effect of agricultural nonpoint pollutants results in potentially damaging concentrations of nitrogen, phosphorus, sediments, turbidity, and pesticide residue in the water bodies. Agriculture is assumed to comprise the majority of the NPS pollution simply because it constitutes 81% of the area in the watershed. The primary mechanism to reduce the amount of sediment and nutrients entering the waterbody is for the farmers to adopt Best Management Practices (BMPs) in order to meet TMDL objectives for the watershed. LDEQ and NRCS composed a list of seven types of BMPs that can be utilized to reduce agricultural NPS loading.

4.3 Urban Runoff

Urban areas compose 4% of the landuses in the watershed. Recent water quality monitoring studies in urban areas have shown that the highest pollutant loading and concentrations usually occur during rainfall events in the first runoff of rain, commonly referred to as the "first flush." In urbanizing an area, impervious surface area such as streets, parking lots, and rooftops, is increased. These smooth, impenetrable surfaces allow little or no detention or infiltration of stormwater. Pollutants that are present between rainfall events in the atmosphere prior to a storm and which accumulate on impervious surfaces are generally carried away in the first 0 to 1 inch of rainfall in moderate to heavy urbanized areas. As precipitation falls on urban areas, it picks up contaminants from the air, littered and dirtied streets and sidewalks; petroleum residues from automobiles, exhaust

Figure 4.1 Parts of the bayou meander nicely in its historical path while other parts have been hydro-modified. Hydro-modification results in stream bank erosion and significantly increases the load into the bayou and hinders its ability to transfer the sediments out of the system.

products, heavy metals and tar residuals from the roads; chemicals applied for fertilization, weed and insect control; and, sediments from construction sites. The dumping of chemicals such as used motor oil and antifreeze into storm sewers is another source of urban NPS pollution. Illegal hookups of storm drains to sanitary sewers can result in increased volumes of flow to waste water treatment plants causing more frequent overflows of sewerage into receiving waters.

Urbanization can impact not only on water quality, but on the hydrologic characteristics of watersheds as well. In undeveloped natural drainage areas, the volume and rate of stormwater runoff from a particular rainfall event is primarily determined by the natural detention and infiltration characteristics of the land, and is related to topography, soil types, and vegetative cover. With less detention and infiltration due to impervious surfaces, runoff volume increases, as well as, the rate of stormwater runoff. Flooding and stream channel degradation in urbanizing watersheds has obvious adverse impacts upon public convenience, safety, and aesthetics, but there are some significant adverse impacts on water quality as well. When streams overflow their banks, there is an increased opportunity for pollutants including trash and debris to enter the flow of water. Erosion of the stream channel represents a significant source of sediment pollution, and the loss of vegetation along stream banks reduces the pollutant assimilation capacity of a stream.

Figure 4.2 This section of the Bayou Queue de Tortue has been dredged and straightened, which results in stream bank erosion downstream when the stream begins to meander again.

4.4 HYDROMODIFICATION

Hydrologic modifications are defined as those activities, which are designed to affect natural stream flow. These types of modifications include bank stabilization, channel alignments, high-flow cutoff devices, instream construction, dredging, locks and dams, levees, spillways, and impoundments. Dredging, channel modifications, and impoundments are a major contributor to the nonpoint source pollution problem. Currently, all of these activities are being pursued in Louisiana waters, mainly for purposes of navigation and flood protection in coastal areas.

The Queue de Tortue watershed receives approximately 57 inches of rainfall annually and has very low elevations and almost no slope. In order to prevent agricultural fields and homes from flooding, maintenance dredging and riparian zone removal has become a "fact of life." Many of the reaches along the bayou and its tributaries lack adequate riparian zones. Landowners and municipal authorities find it necessary to cut down trees and spray

Figure 4.3 Water gains energy as it flows through straightened channels and releases the energy as it meets meandering banks and inevitably the receiving banks lose soil to erosion.

herbicides along the riparian zones in the watershed. The lack of riparian zones reduces the amount of shade over the waterway, and the temperature of the water increases without the benefit of canopy cover from trees and bushes. Root matter from riparian zones also has the added benefit of retaining soils along the stream perimeter and prevents the banks from sheet and rill erosion. Dredging can cause scouring in some areas of the streambed and then deposit the sediments over larger areas. The process disturbs the benthic organisms by removing their habitat an blanketing the streambed. Dredging will also suspend sediments in the water column, increasing turbidity and affecting water organisms.

4.5 HOME SEWERAGE

A significant portion of Louisiana's NPS pollution can be attributed to sewerage runoff from homes, camps, and businesses that are not connected to municipal sewerage treatment facilities. It is estimated that 1,323,600 people in Louisiana treat and dispose of their sewerage with individual waste disposal systems, and that over 50% of these systems are malfunctioning because of incompatible soil types or lack of maintenance. These failing systems are a major cause for water quality degradation in Louisiana's scenic streams and fresh water aquifers. Septic tank systems normally consist of two components, a treatment unit and a disposal unit. The septic tank and soil absorption system is the most common individual waste disposal system used in Louisiana. The purpose of the septic tank is to condition household wastes so that the discharge will readily percolate into the soil. This conditioning is done in a septic tank by the removal of solids by settling and also by decomposition of the soluble organics. The soil then provides additional treatment by the removal of bacteria, organics, and nutrients. One of the main problems with using conventional septic tank soil absorption systems in Louisiana is that 87 percent of the soil associations in Louisiana are considered inadequate for conventional septic tank systems as determined from the Soil Limitation Ratings for Sanitary Facilities. Another major component to the pollution caused by septic tank systems is inadequate enforcement of the State Sanitary Code. A properly designed septic tank consists of a buried, watertight, multiple compartment tank, usually of concrete material, equipped with inlet and outlet devices and scum control baffles.

5.0 PHYSICAL, CHEMICAL, AND BIOLOGICAL CAUSES FOR OXYGEN DEPLETION

5.1 SEDIMENT OXYGEN DEMAND AND REAERATION

The slope of the Queue de Tortue is very gradual and the potential for reaeration is low. The bayou is slow moving and depositional in nature, resulting in continued sedimentation within the streambed. The watershed rests on an alluvial plain where soils are composed of silty loams and clays (see soils map). Organic matter attaches to the clay and silts and creates an oxygen demand as the particles decompose within the waterway. After time, this process results in a layer of muck along the streambed. This layer of muck creates what is commonly referred to as sediment oxygen demand (SOD). Agriculture is the largest contributor to the accumulation of sediments and nutrients to the waterway. Rain events suspend exposed soils and fertilizers, transport them overland, and deposit them in the bayou. Nutrients encourage the growth of aquatic plants and nitrifying bacteria. Respiration consumes DO and the decomposition of the organisms contributes to SOD and/or eutrophication. Sediment oxygen demand is the amount of oxygen consumed by the bacteria as they attack the organic material that has settled or been captured to form a sediment or sludge deposit. Composed largely of particles of organics attached to sediments, feces, dead algae, and decaying plant matter, the accumulated sediments can dominate oxygen dynamics. Both winter and summer fish-kills in natural systems, caused by oxygen depletion, can be attributed to oxygen consumption by the sediments.

5.2 Carbonaceous Biochemical Oxygen Demand

The waterways contain particulate or dissolved organic materials that can serve as food for heterotrophic bacterial communities, which in turn consume large amounts of oxygen. The potential impact of these dissolved organics on the water's oxygen supply is estimated by measuring the water's carbonaceous biochemical oxygen demand (CBOD). The CBOD of a sample is measured by observing the oxygen drop in a sealed bottle over a fixed number of days (usually five). The number of days used in the test is indicated by a suffix, i.e., CBOD5. A high CBOD5 (>15 mg/l) implies that a lot of bacterial activity will occur in the water throughout the day and night as the bacteria attack the suspended or dissolved organics.

5.3 Nitrogenous Biochemical Oxygen Demand

The nitrogenous biochemical oxygen demand (NBOD) is a major cause of oxygen loss in aquatic systems. NBOD is a measure of the amount of oxygen that is consumed by the nitrifying bacteria as they convert total ammonia nitrogen (TAN) to nitrate. Approximately 4.57 milligrams of oxygen are consumed for each milligram of TAN converted to nitrate nitrogen. TAN is directly excreted into the water by a wide variety of aquatic organisms and is very difficult to remove without bacterial activity. Unless the water is rapidly flushed, the water's NBOD must be satisfied within the system. TAN is also produced as a by-product of the decay of sediments and sludges as the bacteria break down proteins and amino acids to form ammonia.

5.4 High Temperatures and Low Flow

Biochemical reactions, in general, follow the van't Hoff rule of a doubling of the reaction rate for a 10^{o}C increase in temperature over a restricted temperature range. Therefore, temperature is strongly inversely proportional to dissolved oxygen levels. July and August are the hottest months in Louisiana, while October and November are the months with lowest stream flows. Dissolved oxygen and runoff are moderately directly proportional. The TMDL analysis concluded that critical conditions for stream DO concentrations were those of negligible nonpoint run-off and low stream flow combined with high stream temperature. When the rainfall and stream flow are high, turbulence is higher due to higher flow and the temperature is lowered due to rainfall run-off. Reaeration rates are much higher when water temperatures are cooler and BOD decay rates are much lower. For these reasons, periods of high loadings are periods of higher reaeration and DO but not necessarily periods of high BOD decay. LDEQ interprets this phenomenon in its TMDL modeling by assuming that the annual nonpoint loading, rather than loading for any particular day, is responsible for accumulated benthic blanket in the stream, which is expressed as SOD or re-suspended BOD. This accumulated loading (SOD) has its greatest impact on the stream during periods of higher temperature and lower flow. NPS pollutant loadings, primarily agriculture, are the major source of this SOD in the Queue de Tortue watershed.

6.0 WASTE LOAD ALLOCATION

6.1 POINT SOURCE DISCHARGES IN BAYOU QUEUE DE TORTUE

There are 30 known dischargers in the watershed, the majority of which are too small to have a significant impact on water quality in the watershed. Limits for the small discharges are generally set by state policy. Only one of the point sources will require more stringent effluent limitations to meet dissolved oxygen criteria (City of Dawson Sewage Treatment Plant). Reductions from point sources will be addressed in revisions to discharge permits. Table 6.1 that compares the point source, headwaters and tributaries, incremental, and NPS discharges in the Bayou Queue de Tortue watershed.

6.2 TMDL BOD LOAD IN BAYOU QUEUE DE TORTUE

This section describes how LDEQ determined the TMDL for the waterbody. The TMDL instream model (LA QUAL) describes the amount and distribution of oxygen demanding materials or biological oxygen demand (BOD) in the waterway. The ultimate BOD (UBOD) includes both the nitrogen (NBOD) and carbon (CBOD) based forms of BOD. LDEQ models for critical conditions called the 7Q10, which are the 7 consecutive lowest flow days from a 10-year period. The LA QUAL model partitions the BOD load to several different sources and divides the bayou into stream reaches from the headwaters to the end of the waterbody. LDEQ collects water quality samples along the waterway to establish a BOD load and to calibrate the model. Once the total BOD load is determined, it is partitioned into point sources and NPS sources, plus a margin of safety is factored in to accommodate any potential errors. Point sources require a LPDES discharge permit, which identifies its location and sets a limit on the amount of BOD load that can be discharged out the end of the pipe. The modelers are able to subtract the point source load from the measured and modeled total BOD load. The rest of the BOD load is either assigned to natural or manmade NPS pollution. In the Bayou Queue de Tortue, <1% of the total BOD load was assigned to point sources.

The TMDL segregates the remaining pollutant load into 3 categories: Sediment Oxygen Demand (SOD), Man-made Nonpoint, and Incremental. Also, the model can account for headwaters if there are any in the stream system. Therefore, the model distributes BOD loads by stream reach and then estimates whether the pollutant load is SOD, Incremental, or Man-made Nonpoint.

6.3 LA QUAL MODELING RESULTS

In the following tables, the total BOD and partitioned BOD loads are distributed by reach, beginning at the top of the watershed. The values are the results of calibrated data during 7Q10 periods, which represents the amount of suspended and benthic materials present in the bayou at the time of sampling. It should be noted that since samples were collected during low flow conditions, they represent only a portion of the pollutant load delivered to the bayou. It is what remained in the bayou during the lowest flow conditions. The sediment oxygen demand (SOD) portion of the total load (24%), is defined as the oxygen demand exerted by the bottom sediments.

The following tables and charts do indicate where the BOD load resides. As you can see, the BOD load tends to increase towards the bottom of the watershed. One reason that BOD materials collect and reside towards the lower end of the watershed is because of the channel slope. The elevation in the upper portion of the watershed is 56 ft and the elevation near the bottom of the bayou is at sea level. The sediments and the BOD load will collect where the bayou levels out until a large rain event produces enough hydraulic head to push the material down stream eventually into the Gulf of Mexico. Secondly, the lower end of the watershed is a region cultivated mainly with rice. Rice constitutes a major portion of the NPS pollutant load in the watershed. The BOD increases towards the bottom of the bayou due to lack of elevation and its proximity to the largest contributor of NPS pollutants.

6.4 TMDL Model Reaches

The bayou was sub-divided into seventeen separate reaches during the development of the TMDL. Nonpoint loading values for each of these reaches have been calculated using the calibration data from the TMDL model.

The areas above the City of Duson are defined as headwaters. Depending upon the source, there are different interpretations of where these headwaters actually begin, thus affecting the reported length of the bayou. According to the LDEQ Use Attainability Analysis (UAA) from 1988, the headwaters begin east of the Town of Mire, and the length of the bayou is reported to be 56 miles (90 km). The TMDL defines the headwaters as being everything upstream of the City of Duson STP, with the bayou length at just under 46 miles (74 km).

Reaches 1 through 6 are similar in nature with tree-lined banks, a narrow channel and relatively shallow depth. This area is meandered, but does show some channelization effects of dredging conducted by the State of Louisiana to alleviate flooding.

Extensive hydromodification has occurred in the bayou from approximately reach 7 through reach 13. Reaches 7 through 10 still remain fairly meandered, despite dredging to increase the depth and storage capacity. The most noticeable effects are from reach 10 to reach 14, where the bayou has been straightened and channelized, creating a square cross-section and a flat streambed gradient. The bayou has been periodically dredged in order to alleviate flooding as well as to provide sufficient water for rice irrigation. The resulting unstable spoil banks are highly erosive and cause a large amount of clay to become suspended in the water column.

The area between the Lyons Point Gulley (reach 14) and the Mermentau River (reach 17) is less disturbed than other sections of the bayou. The channel in this area is highly meandered, and very wide. Water often extends well into the tree-line, and rooted macrophytes are present well into the waterway in many areas, creating a swampy appearance. This area acts as a large settling basin, and the water appears less turbid and takes a reddish brown hue from the humic acid input from the adjacent swamplands.

6.5 TRIBUTARIES

According to the vector diagram utilized in development of the TMDL, twelve tributaries have been associated with Bayou Queue de Tortue. These tributaries are considered to be perennial, and due to the fact that there was no measurable flow at the time of the watershed survey, none of the twelve were simulated as point sources in the bayou. Lyons Point Gully, Coulee Des Iles, and Indian Bayou are all waterbodies which drain large areas within the Bayou Queue de Tortue watershed. Each of these tributaries are located in areas with the highest density of rice cultivation.

Indian Bayou converges with Queue de Tortue near river km 55. It flows nearly east – west, and extends to the edge of the subsegment. It drains a significant portion of the northeastern area of the watershed. Coulee des Iles empties into Queue de Tortue in near the middle of the most highly hydromodified reaches at approximately km 35. This tributary drains the southern portion of the subsegement and incorporates input from Bayou Grand Marais. Lyons Point Gully converges with Queue de Tortue near km 27. The area where these tributaries flow into Queue de Tortue is one of the largest swampy locations in the watershed. There is not a definite point of discharge into the bayou in the form of a flowing channel. Both gullies discharge into a large swamp that borders approximately 7 miles of Bayou Queue de Tortue. This area marks the transition between the extensively hydromodified area and the highly meandered areas of the bayou.

Table 6.1

(Main Channel) Bayou Quedede Torte TMDL Loading by Reach and Description of Reach

Reach Identification		Reach Description				BOD Loading by Reach				BOD Loading by River Kilometer				
Reach #	Reach Name	Beginning of reach (km)	End of reach (km)	Width of reach (m)	Length of reach (km)	Nonpoint load (kg/day)	SOD load (kg/day)	Incremental load (kg/day)	Headwaters and Tributaries (kg/day)	Nonpoint load (kg/day/river km)	SOD load (kg/day/river km)	Incremental load (kg/day/river km)	Headwaters and Tributaries (kg/day/river km)	Total Loading by kg/day/river km
1	QDT Above Duson STP	74.0	73.3	3.1	0.7	65.2	8.5	18.7	2.8	93.2	12.2	26.8	4.0	136.1
2	QDT Duson STP to Unnamed Canal (RBD)	73.3	71.7	2.9	1.6	149.1	18.3	43.0	0.0	93.2	26.1	61.4	0.0	180.7
3	QDT Unnamed Canal (LBD) to bifurcating / agumenting tributary	71.7	70.1	2.7	1.6	152.1	21.4	43.0	0.0	95.0	30.5	61.4	0.0	187.0
4	QDT bifurcating / augmenting tributary to La 720	70.1	67.1	2.5	3.0	268.3	44.6	80.7	0.0	89.4	63.8	115.3	0.0	268.5
5	QDT La 720 to Unnamed Canal (RBD)	67.1	65.4	2.3	1.7	153.1	27.3	48.5	0.0	90.1	38.9	69.3	0.0	198.3
6	QDT Unnamed Canal (RBD) to Unnamed Canal (LBD)	65.4	62.8	3.7	2.6	24.2	71.4	74.1	0.0	9.3	102.0	105.8	0.0	217.1
7	QDT Unnamed Canal (LBD) to Indian Bayou	62.8	55.4	8.5	7.4	358.5	473.4	211.0	0.0	48.4	676.3	301.4	0.0	1026.2
8	QDT Indian Bayou to Unnamed Canal (RBD)	55.4	48.7	12.4	6.7	645.0	498.5	0.0	0.0	96.3	712.1	0.0	0.0	808.4
9	QDT Unnamed Canal (RBD) to La 92 USGS station	48.7	47.3	16.4	1.4	252.1	126.3	0.0	0.0	180.1	180.4	0.0	0.0	360.5
10	QDT La 92 USGS Station to Ricefield Drainage Canal	47.3	45.6	20.4	1.7	380.1	242.8	41.2	0.0	223.6	346.8	58.9	0.0	629.3
11	QDT Ricefield Drainage Canal to Prime Gulley	45.6	36.8	25.5	8.8	3443.5	1797.3	213.2	0.0	391.3	2567.6	304.6	0.0	3263.5
12	QDT Prime Gulley to Coulee de Iles	36.8	35.3	29.5	1.5	708.1	375.6	36.4	0.0	472.0	536.6	52.0	0.0	1060.6
13	QDT Coulee de Iles to Lyon's Point Gulley	35.3	27.1	29.6	8.2	4431.1	2063.1	198.7	0.0	540.4	2947.3	283.8	0.0	3771.5
14	QDT Lyons Point Gulley to La 91 USGS Station	27.1	23.6	25.6	3.5	1847.8	627.2	84.9	0.0	527.9	896.0	121.3	0.0	1545.2
15	QDT La 91 USGS Station to Lazy Poitn Canal	23.6	15.4	31.0	8.2	3463.4	1397.6	198.7	0.0	422.4	1996.6	283.8	0.0	2702.8
16	QDT Lazy Point Canal to Unnamed Canal (LBD, Alvie Broussard's Boat Launch)	15.4	7.7	58.4	7.7	6767.4	1123.6	186.5	0.0	878.9	1605.2	266.5	0.0	2750.5
17	QDT Unnamed Canal (LBD< Alvie Broussards Boat Launch) to Mermentaue River	7.7	0.0	43.1	7.7	5571.7	830.3	186.5	0.0	723.6	1186.1	266.5	0.0	2176.2
Totals						28680.6	9747.2	1665.1	2.8					

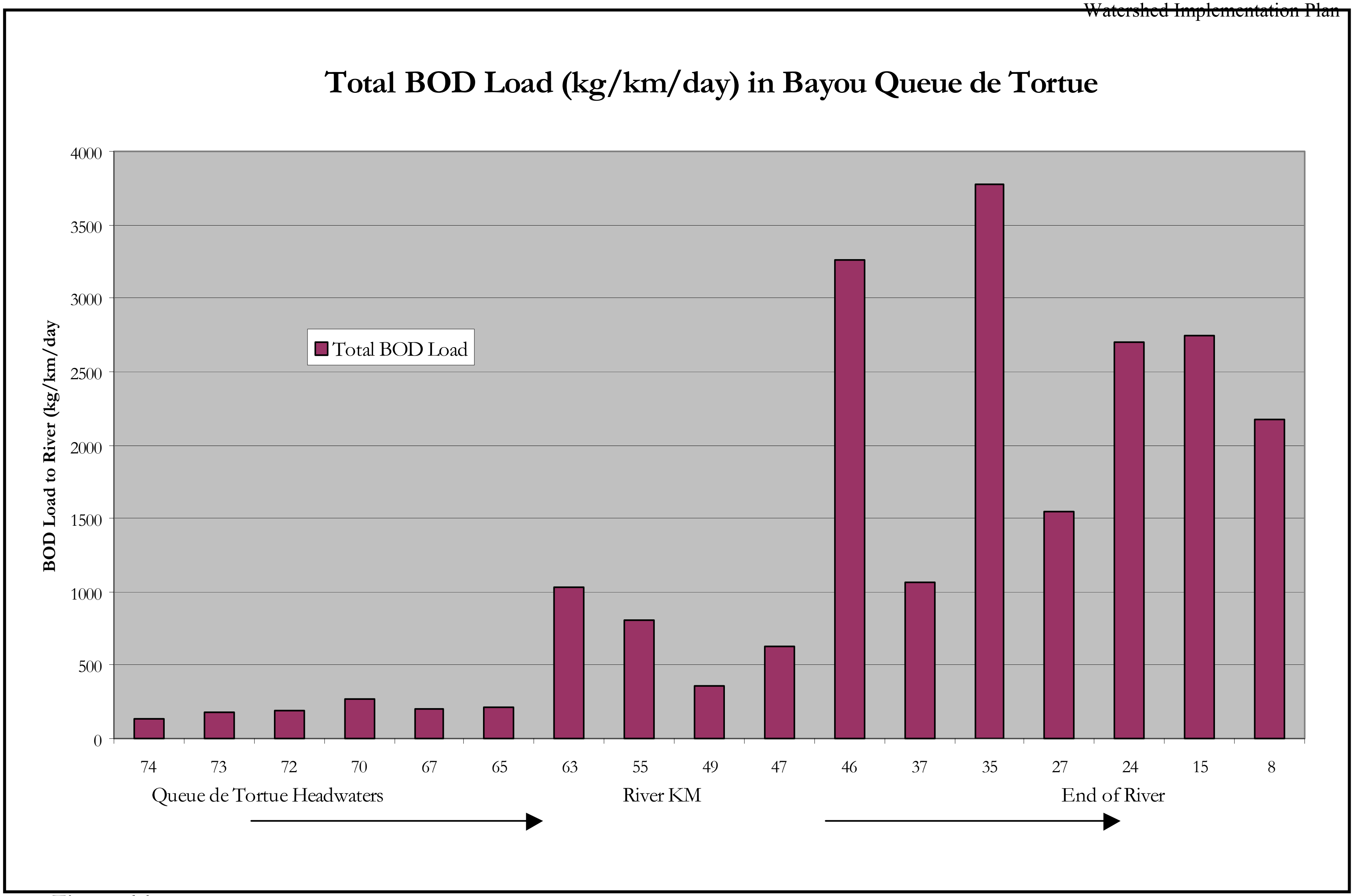

Total BOD Load (kg/km/day) in Bayou Queue de Tortue
BOD Load to River (kg/km/day
4000
3500
3000
2500
2000
1500
1000
500
0
Total BOD Load
74
73
72
70
67
65
63
55
49
47
46
37
35
27
24
15
8
Queue de Tortue Headwaters
River KM
End of River

Figure 6.1

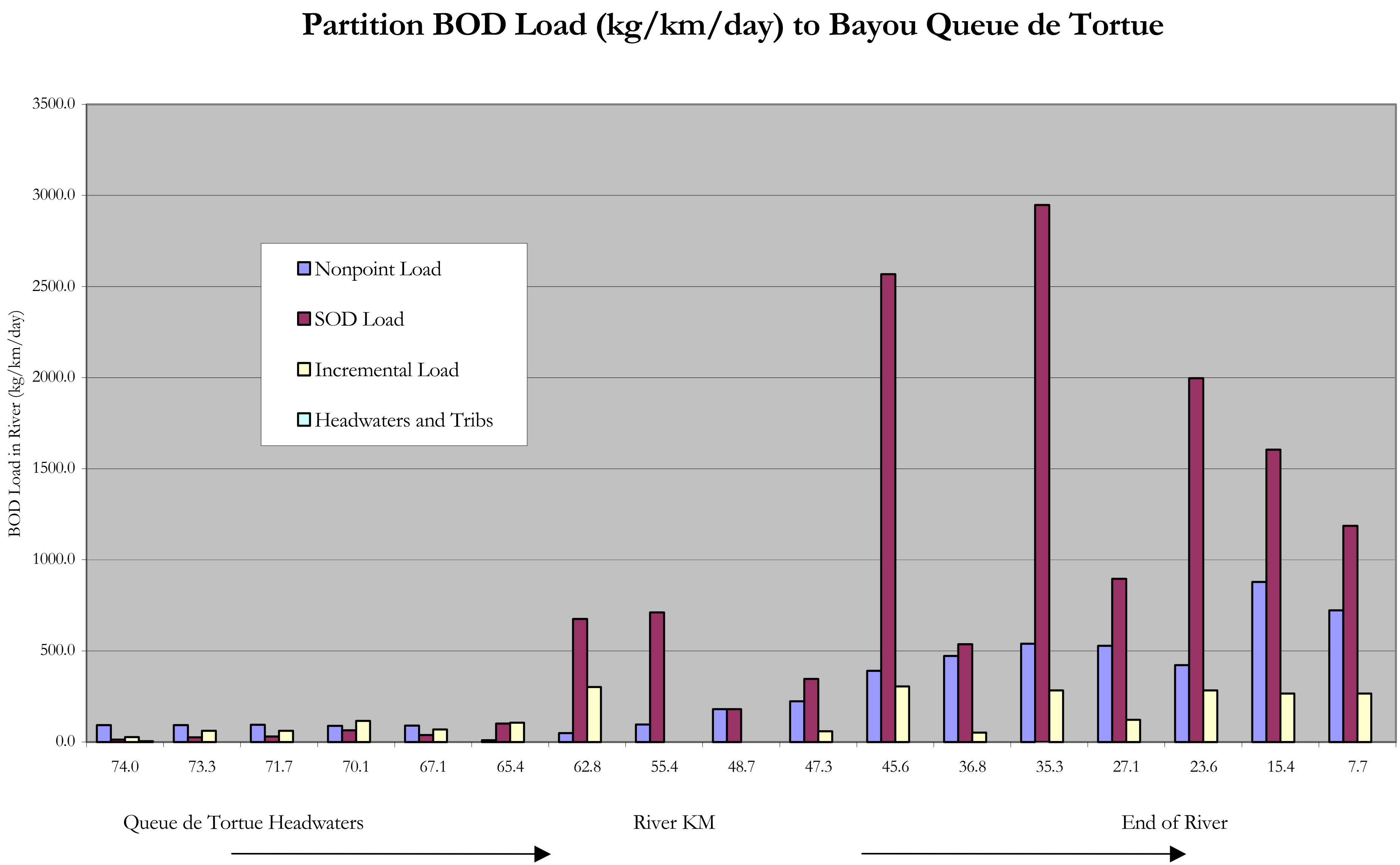

Partition BOD Load (kg/km/day) to Bayou Queue de Tortue
BOD Load in River (kg/km/day)
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
Nonpoint Load
SOD Load
Incremental Load
Headwaters and Tribs
74.0
73.3
71.7
70.1
67.1
65.4
62.8
55.4
48.7
47.3
45.6
36.8
35.3
27.1
23.6
15.4
7.7
Queue de Tortue Headwaters
River KM
End of River

Figure 6.2

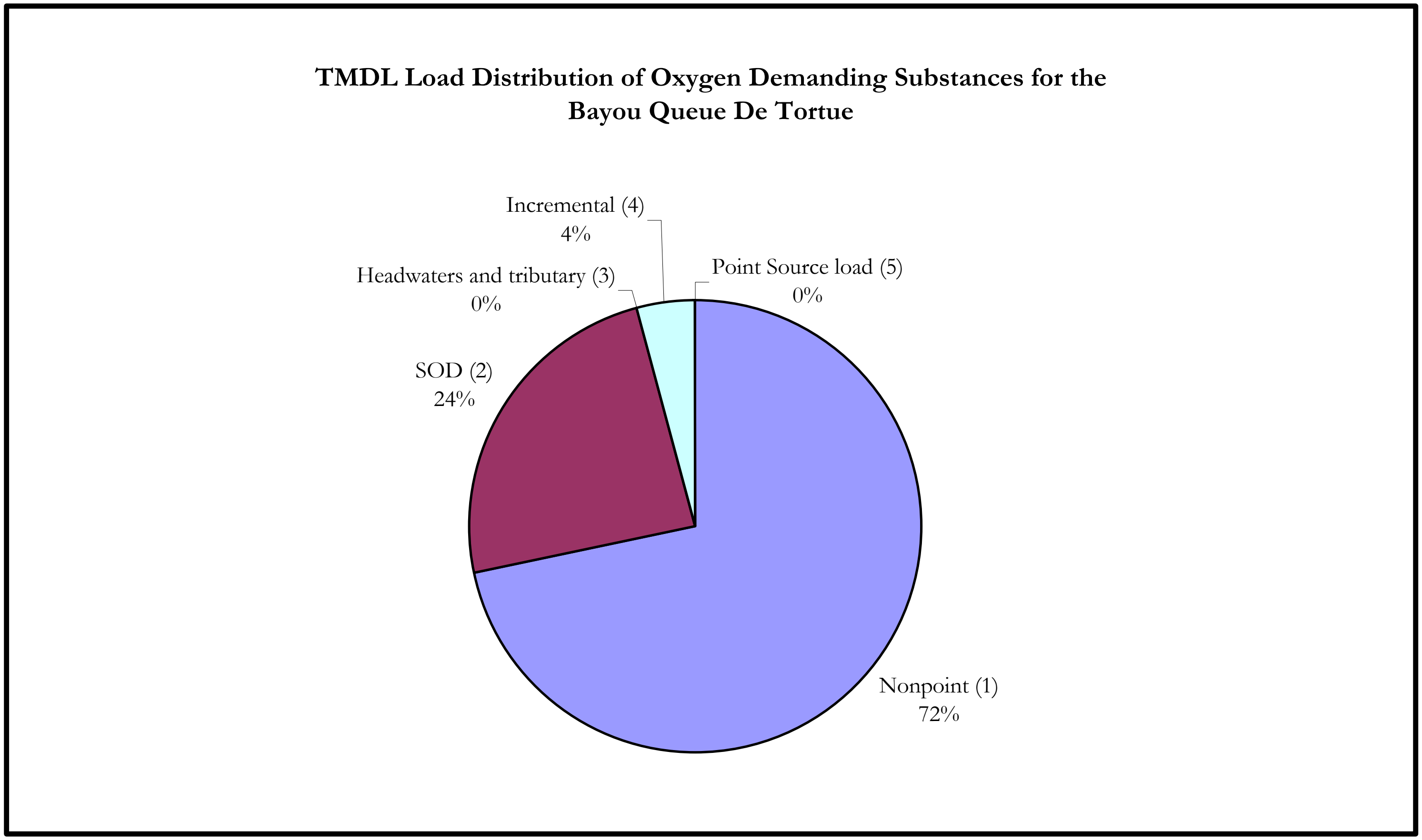


Figure 6.3 (1) Nonpoint load is defined as the portion of the BOD (both NBOD and CBOD) that is suspended in the water column. (2) Sediment oxygen demand (SOD) is defined as the benthic load that resides on the stream bottom. (3) Headwaters and tributaries are the BOD loads associated with tributaries and headwaters. (4) Incremental load includes ground water, NPS from rain events, and tributaries. (5) Waste loads are the share of pollutants discharged from industrial and municipal point sources in the waterway. To clear matters up, consider this: if you were to step into a muddy creek and sunk into the mud up to your knees, the mud you sank into is the SOD (2) and the murky water above the mud is what the model considers the Nonpoint load. What is commonly considered a NPS load is included in the Incremental load (3) parameters and is negligible, only 4% of the total load.

7.0 Best Management Practices Implementation Plan: Achieving goals in Watershed

7.1 Introduction

The TMDL goal is to reduce NPS loading of oxygen demanding substances by 60%. Fields with a rice and soybean rotation compose the majority of the pollutant load in the watershed. A 60% reduction in sediments can be achieved with a promising BMP for rice called "clear field planting." Also, "precision leveling" dramatically reduces the amount of sediments that runs off into the waterways. Many farmers are embracing these new BMPs over this 2002 growing season. However, it will still be necessary to initiate an implementation plan, set measurable goals and milestones, and begin a monitoring plan to sample any improvement in the watershed as the result of BMP implementation. Stake holder participation is a necessary component of any successful watershed implementation plan and the local community will be encouraged to get involved in the effort to reduce the NPS pollutant loads in the watershed. A schedule to meet goals outlined in the TMDL will be presented after this section and methods to monitor progress in the watershed and sources to finance BMP implementation will be discussed.

7.2 Modeling the Bayou Queue de Tortue

As the watershed approaches the Gulf of Mexico, land elevations begin to level out for several miles and stream currents slow down and sometimes reverse due to strong tides and winds. Watershed models are driven by slope and weather, however, there is no slope in the southern regions of the Queue de Tortue. Much of the water is directed through dredged channels and cut ditches. The standard Digital Elevation Model (DEM) with 1m vertical resolutions is not useful to generate any sensible stream network in the area. As seen on the next figure, the bayou heads abruptly south to the Gulf of Mexico when it should be flowing east to the Mermentua River.

7.3 Similarities Between Plaquemine Brule and Queue de Tortue

The watershed just north of Bayou Queue de Tortue, Bayou Plaquemine Brule, is very similar in land-use and soils and was modeled successfully. The Plaquemine Brule watershed is a suitable candidate for a surrogate watershed. The results just to the north suggest that discharges from rice fields during spring planting contribute >60% of the sediment load in the watershed. The next few pages illustrate the similarities of the two watersheds.

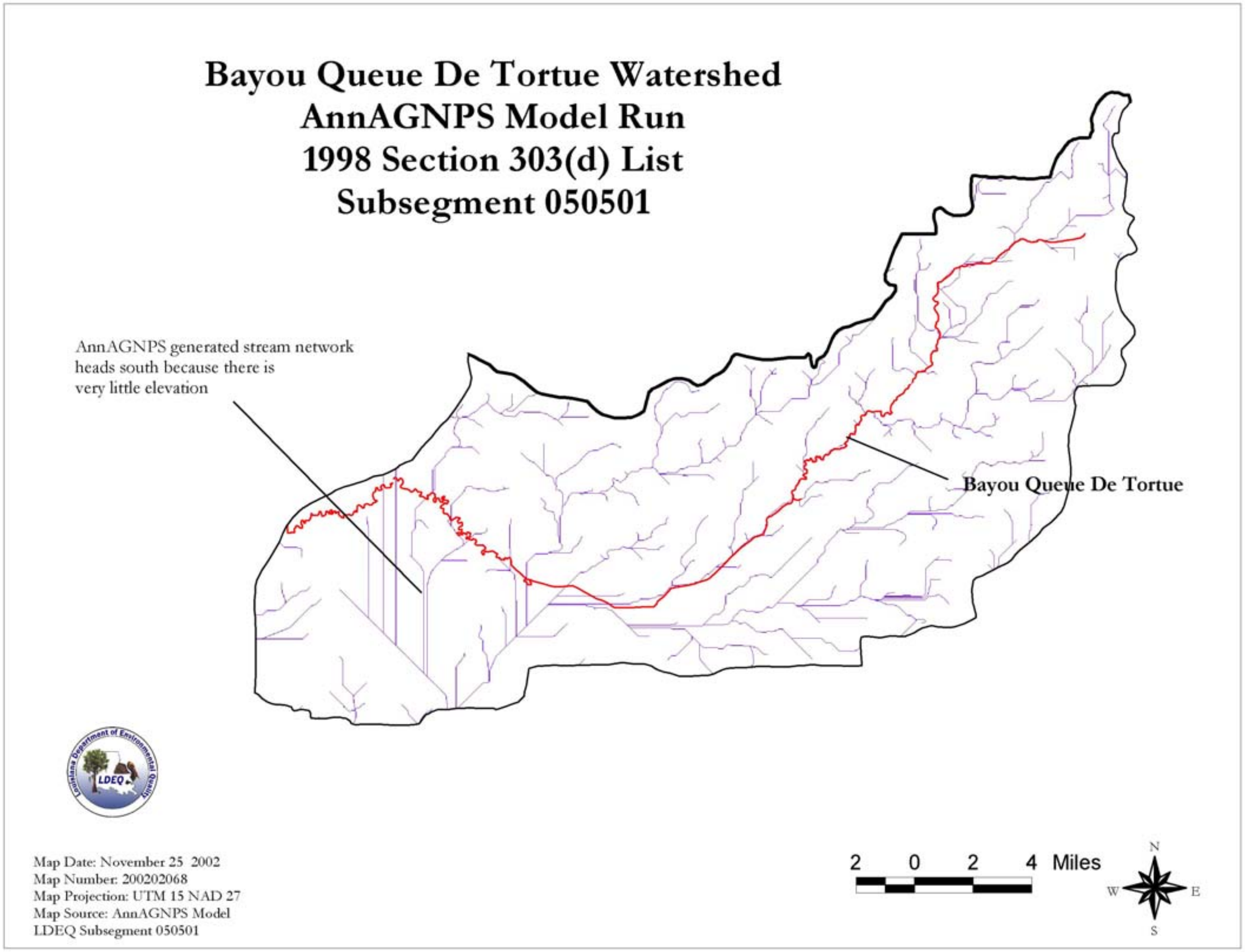


Figure 7.1 Elevation change in the SW region of the Queue de Tortue is so slight that AnnAGNPS is unable to generate a stream network that follows the actual path of the bayou.

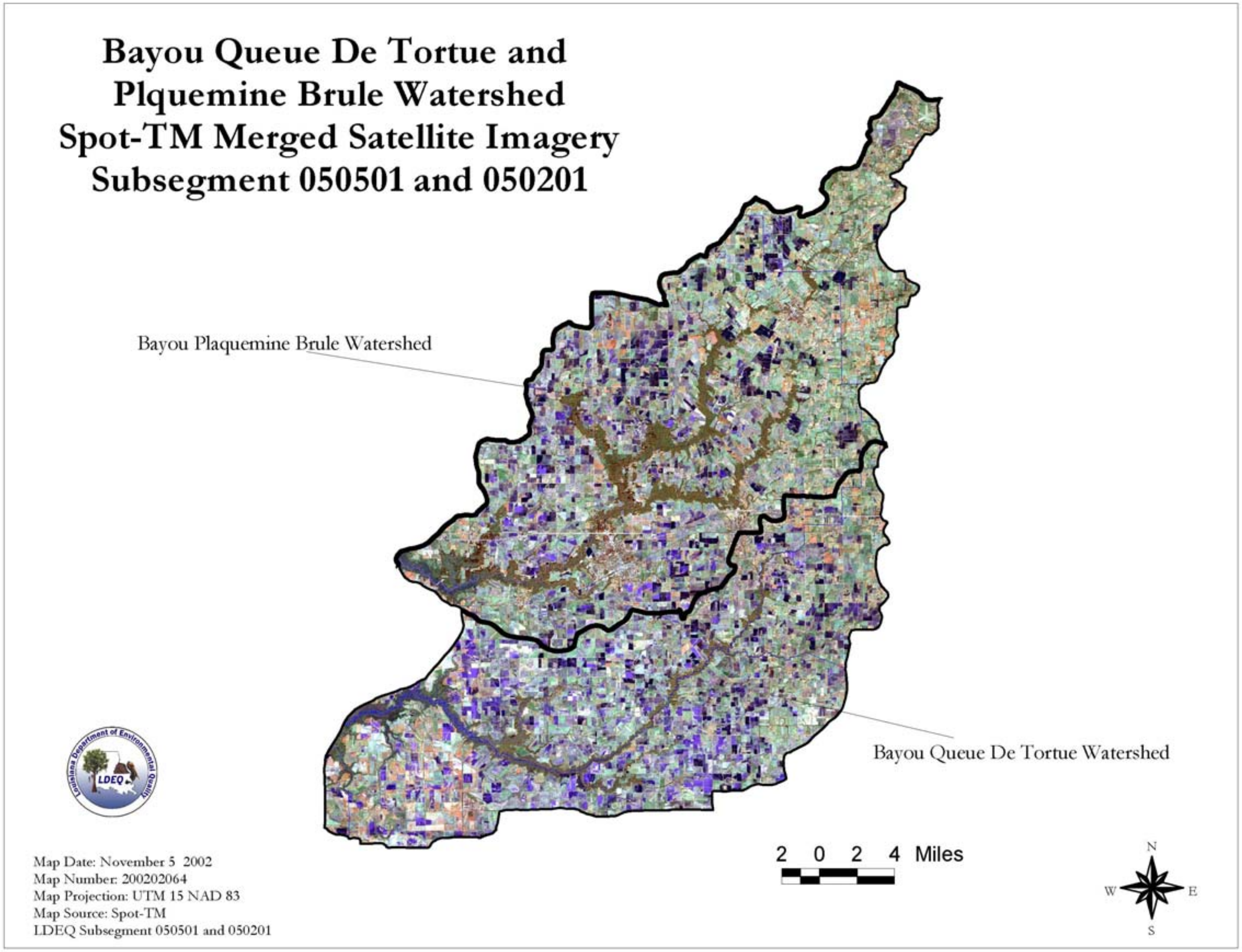


Figure 7.2 Bayou Plaquemine Brule and Queue de Tortue are very similar in landuse, soils, and rainfall, and famers practice similar operational procedures.

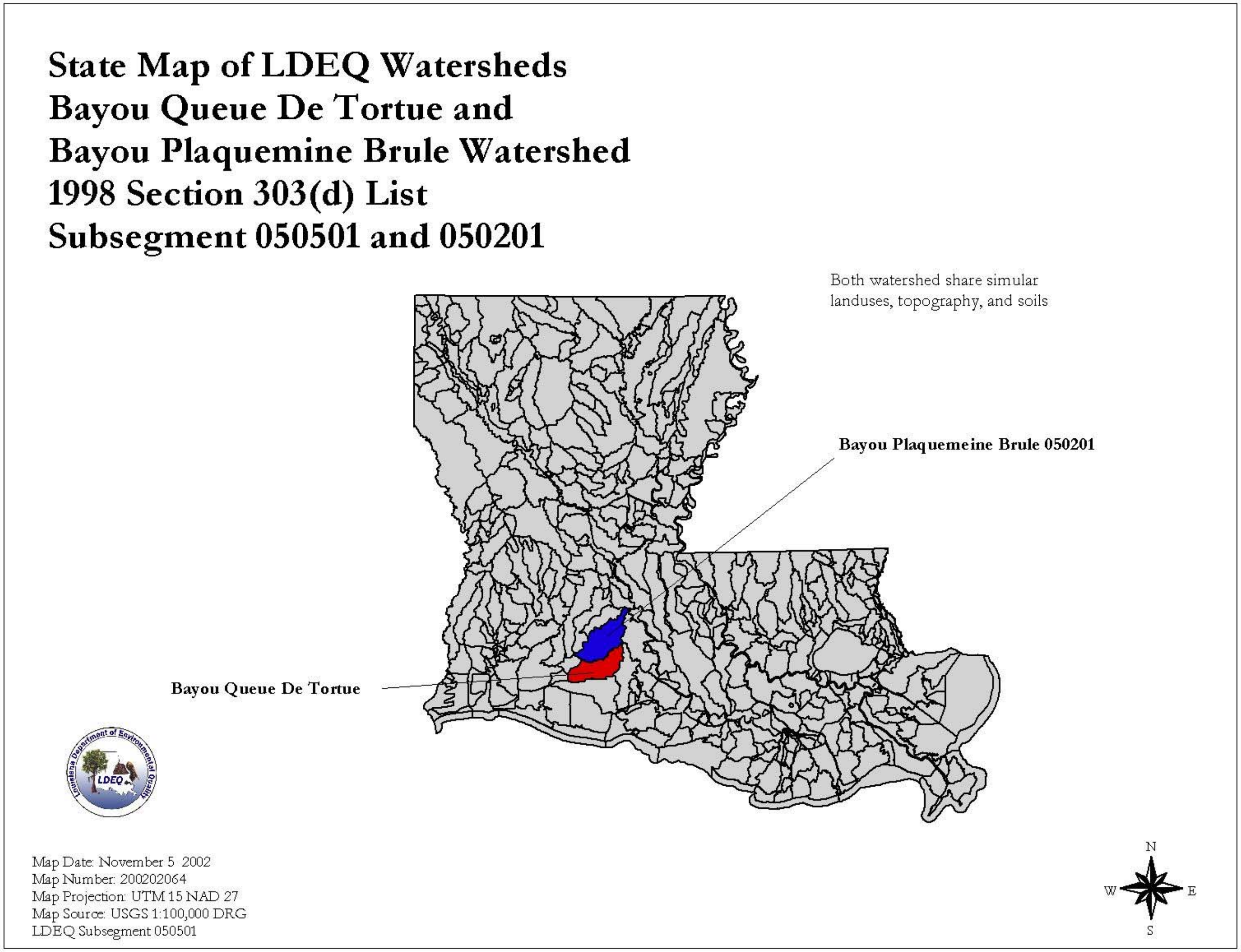


Figure 7.3 The 2 watersheds are both located in the same Basin and Eco-region.

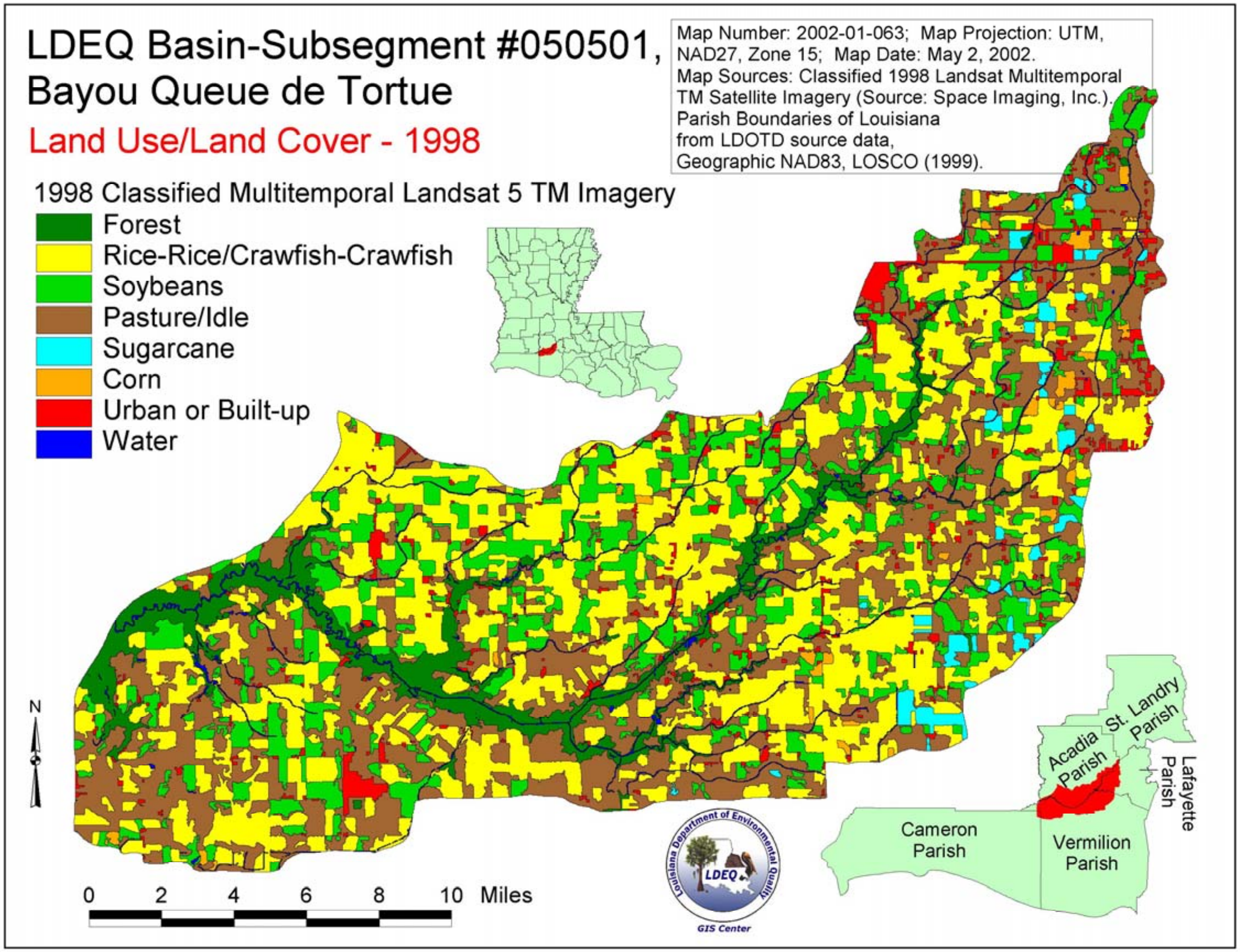


Figure 7.4 Compare landuses to the Plaquemine Brule.

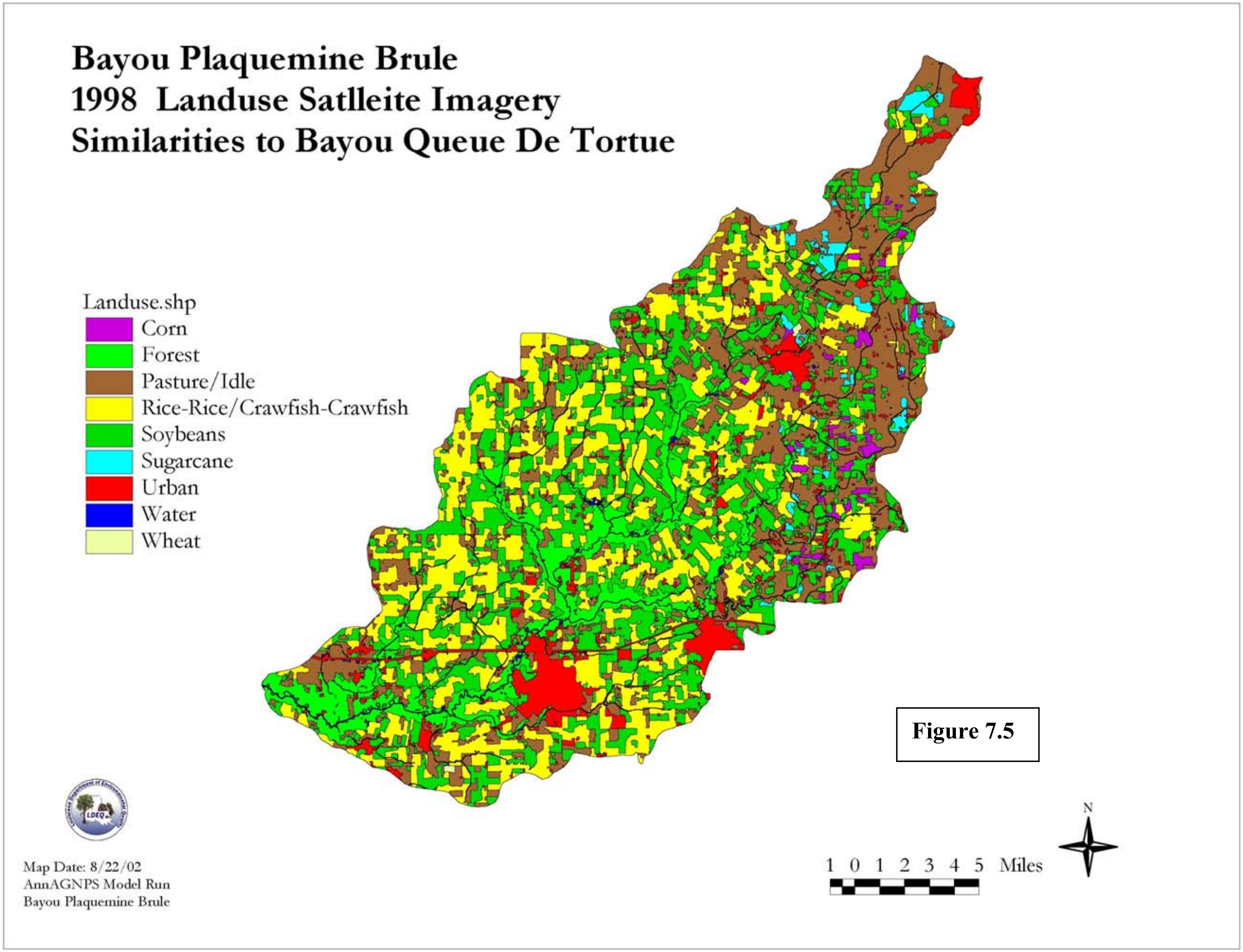

Bayou Plaquemine Brule
1998 Landuse Satlleite Imagery
Similarities to Bayou Queue De Tortue
Landuse.shp
Corn
Forest
Pasture/Idle
Rice-Rice/Crawfish-Crawfish
Soybeans
Sugarcane
Urban
Water
Wheat
Map Date: 8/22/02
AnnAGNPS Model Run
Bayou Plaquemine Brule
1 0 1 2 3 4 5 Miles
N

Figure 7.5

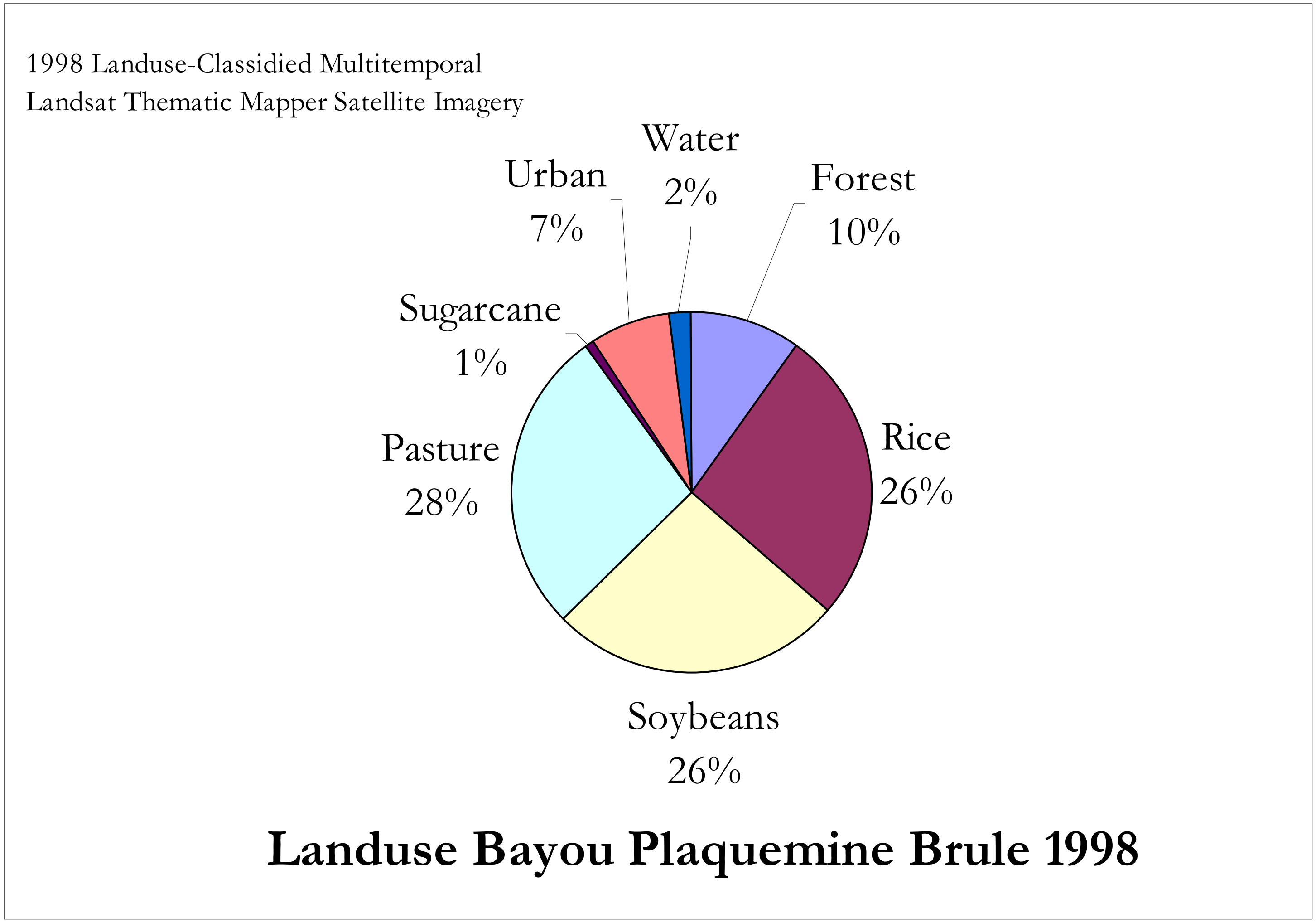


Figure 7.6 Rice and soybeans are rotated from one year to the next in the watershed. 52% of the area in the Queue de Tortue watershed is utilized for rice/soybean agriculture.

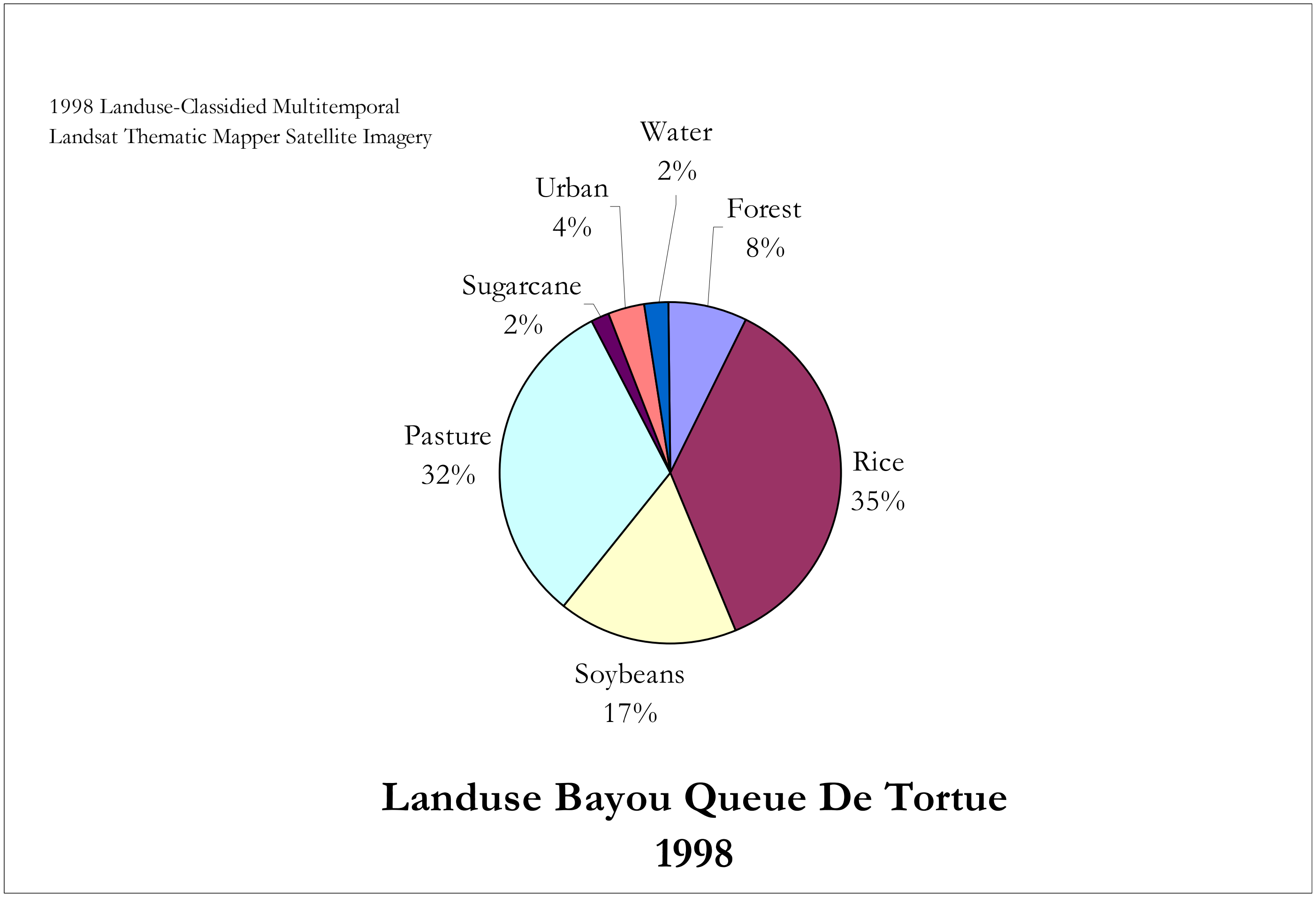


Figure 7.7 Rice and soybeans are rotated from one year to the next in the watershed. 52% of the area in the Plaquemine Brule watershed is utilized for rice/soybean agriculture.

7.4 MODELING: ANNAGNPS AND BMPS:

In order to achieve a 60% reduction of NPS pollution in the watershed, a significant portion of the farmers will need to implement BMPs. LDEQ is utilizing a model called **Ann**ualize **A**griculture **N**on-**P**oint-**S**ource (AnnAGNPS), a Natural Resources Conservation Service (NRCS) sponsored model, to evaluate current agricultural practices and compare them to various BMPs. The model produces results on sediment, phosphorus, nitrogen, pesticides, and organics as the constituents travel overland, through the reaches and out the watershed outlet. It is an extremely robust model having over 900 input parameters. Cells (land area representations) of a watershed are used to provide landscape spatial variability. Each cell homogeneously represents the landscape within its respective land area boundary. The physical or chemical constituents are routed from their origin within the land area and are either deposited within the stream channel system or transported out of the watershed. Pollutant loadings can then be identified at their source and tracked as they move through the watershed system.

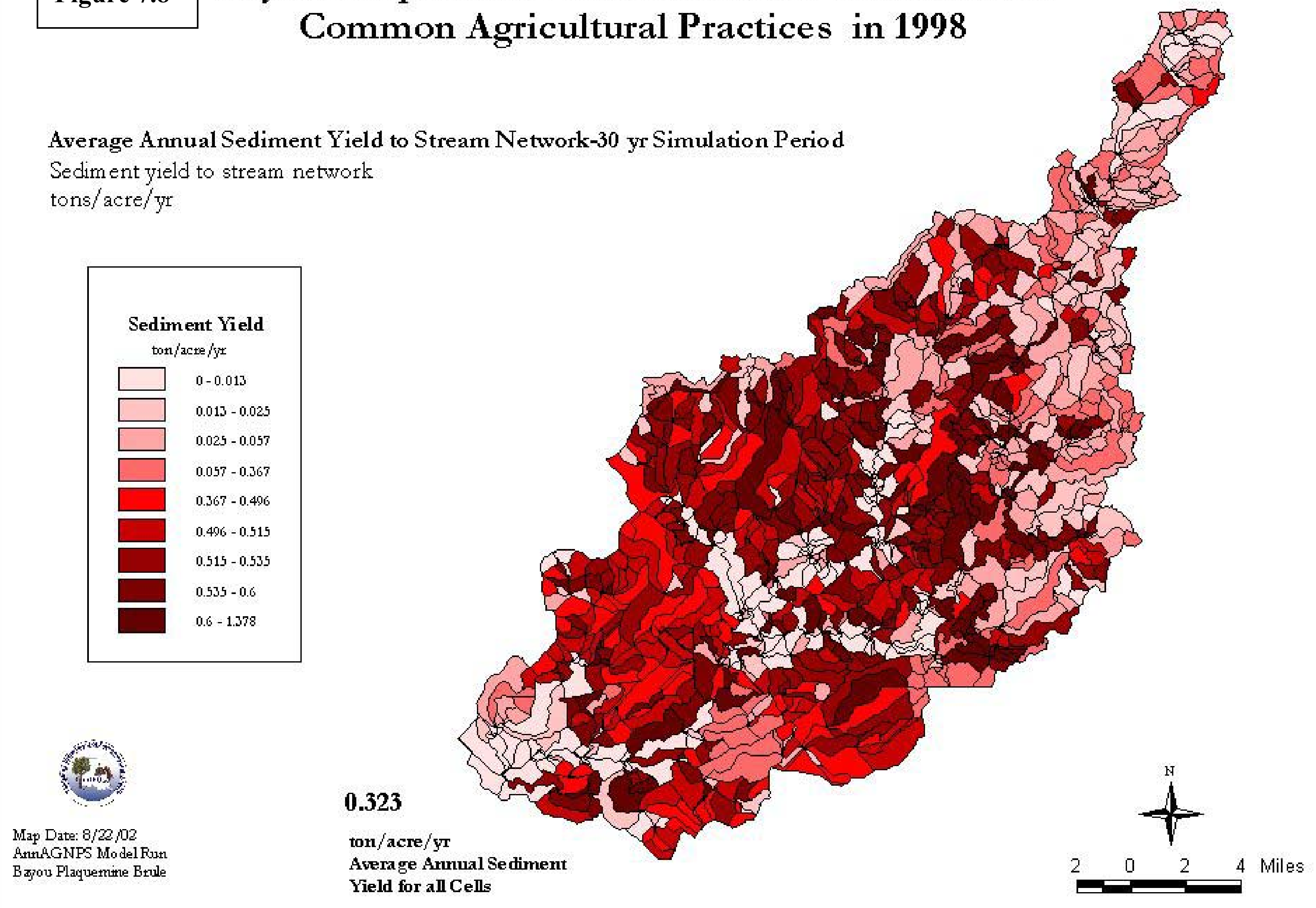
Operational practices are a key variable. LDEQ utilized information recommended by LSU AgCenter and conservation practices found in the publications listed in the bibliography, and recommendations from the local farmers, for input parameters. The model will enable LDEQ to run BMPs to arrive at the combination of BMPs to reach the 60% reduction in anthropomorphic NPS pollution. The model also helped identify hot spots in the watershed where management practices are most needed and have the greatest affect.

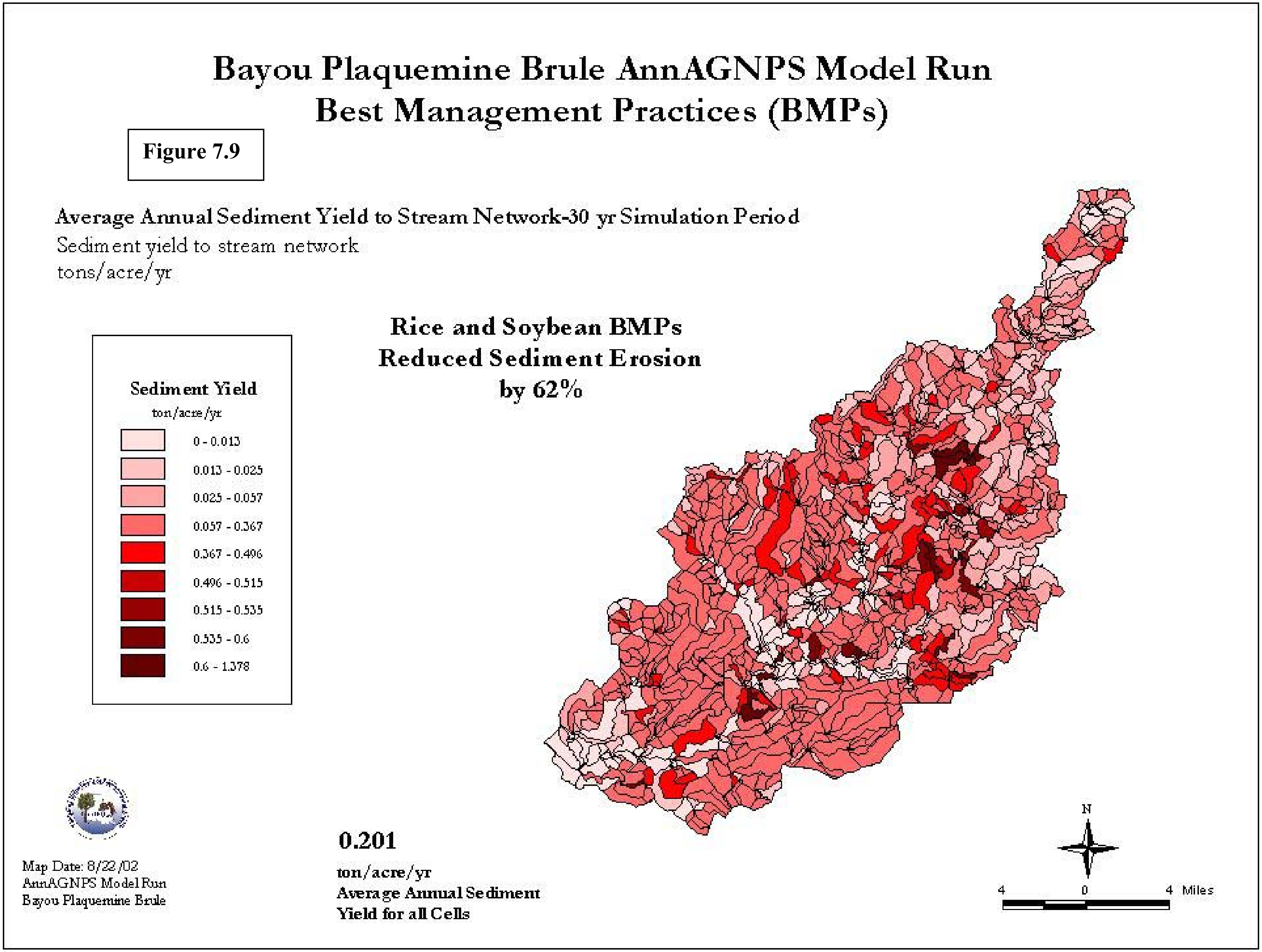
7.5 MODELING: ANNAGNPS AND BMP IMPLEMENTATION

Results from AnnAGNPS are presented below. The first model run shown below is of standard agricultural operations commonly practiced in 1998 when the watershed was sampled for pollutants that resulted in a failure to meet water quality standards and in which it was listed for a high priority for TMDL assessment. The local Soil and Water Conservation District (SWCD) representatives from Acadia and St. Landry Parish were consulted to depict common operational practices. Secondly, the model was run utilizing BMPs for rice and soybeans. In 1998 and earlier, high concentrations of sediments reach the waterways after the farmers released large quantities of water from rice fields after mud leveling fields and again after planting during the spring. Numerous fish kills have been reported during these spring water releasing events.

The Spring release of rice field discharges represents the majority of sediment load to the waterways. The BMPs for rice such as precision leveling and Clearfield planting eliminate the spring discharges i.e. the majority of the sediment load to the bayous. The remainder of the year, the effluents are fairly clean because of the abundance of plant and root material that retains the sediments in the impounded fields. Over the winter the levies and the pipe drops remain closed so there is very little discharged from the rice fields-except during large rain events when there is an excess of water.

Figure 7.8 **Bayou Plaquemine Brule AnnAGNPS Model Run Common Agricultural Practices in 1998**




Bayou Plaquemine Brule AnnAGNPS Model Run
Best Management Practices (BMPs)
Figure 7.9
Average Annual Sediment Yield to Stream Network-30 yr Simulation Period
Sediment yield to stream network
tons/acre/yr
Rice and Soybean BMPs
Reduced Sediment Erosion
by 62%
Sediment Yield
ton/acre/yr
0 - 0.013
0.013 - 0.025
0.025 - 0.057
0.057 - 0.367
0.367 - 0.496
0.496 - 0.515
0.515 - 0.535
0.535 - 0.6
0.6 - 1.378
Map Date: 8/22/02
AnnAGNPS Model Run
Bayou Plaquemine Brule
0.201
ton/acre/yr
Average Annual Sediment
Yield for all Cells
N
4
0
4 Miles

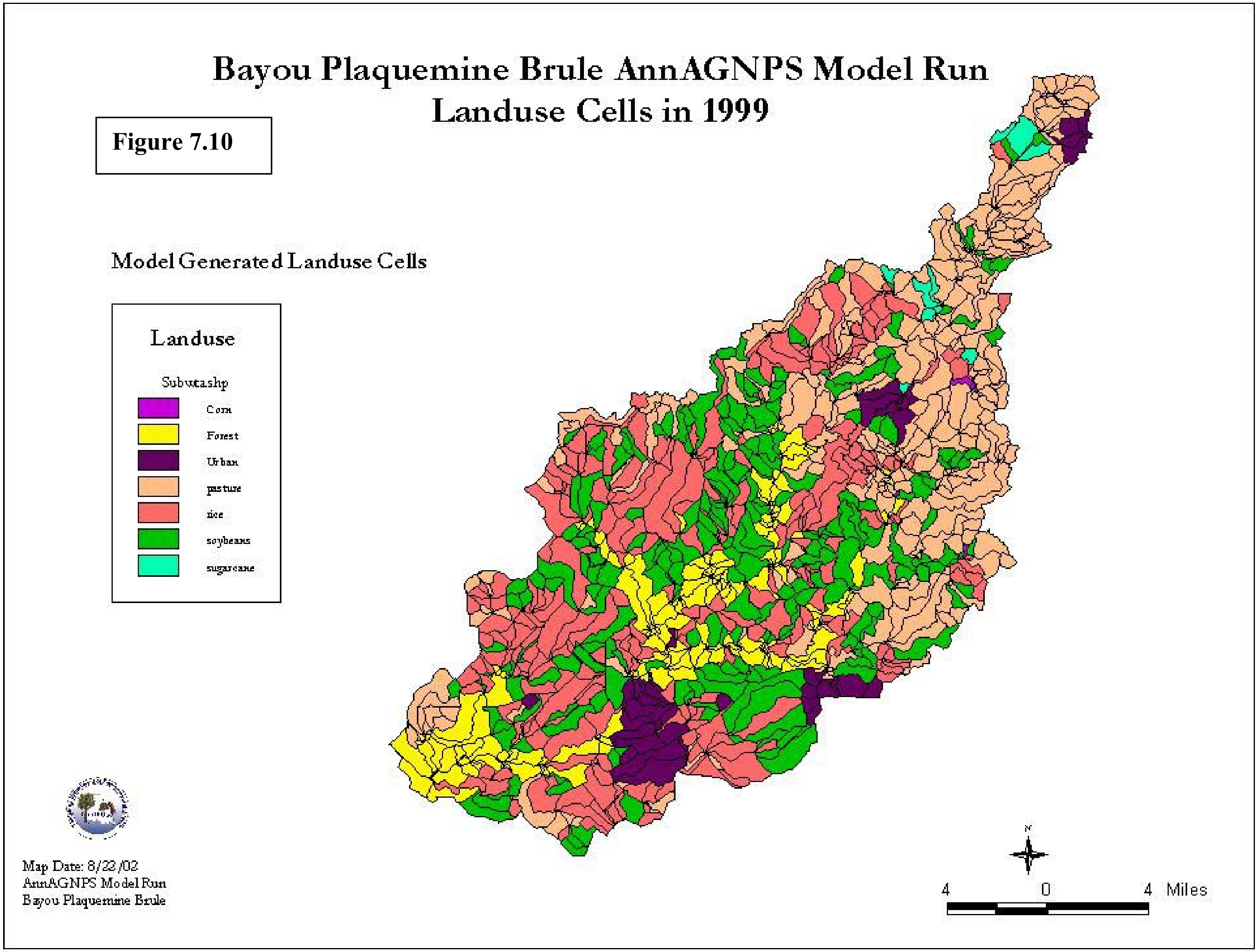

Bayou Plaquemine Brule AnnAGNPS Model Run
Landuse Cells in 1999
Figure 7.10
Model Generated Landuse Cells
Landuse
Subwtashp
Corn
Forest
Urban
pasture
rice
soybeans
sugarcane
Map Date: 8/22/02
AnnAGNPS Model Run
Bayou Plaquemine Brule
4
0
4 Miles

FIGURE 7.11 The scene above depicts the SW region of Bayou Queue de Tortue and shows turbid rice fields just after mudding in. Farmers will retain the water in the fields up to 2 week to allow silt and clay to settle out of the water. The rice is rotated with soybeans and the vegetated field in the lower right hand in the picture is growing soybeans this season.

7.6 AnnAGNPS Model Run for 1998 Agricultural Practices

Standard agricultural operations for 1998 were entered into the AnnAGNPS model to reconstruct conditions that occurred the year Bayou Queue de Tortue landed on the 303 (d) TMDL list. In the DO TMDL, NPS reductions of 60% were based on this data. In this section of the watershed, rice is rotated with soybeans so there is not really any difference between the cells labeled as rice or soybeans-simply because they rotate with each other. The results are rendered in standard tons/acre/year and range from 0.01 tn/acre/yr to 1.38 tn/acre/yr. Sediment Yield is the amount of sediment that runs off the digital land cells and into the stream network. In other words, sediment yield is the loading of sediments into the stream reaches. The average sediment yield for the whole watershed is 0.323 tn/acre/yr in the 1998 AnnAGNPS model run.

7.7 Forested Areas/Riparian Areas

Riparian or forest cell areas along the bayou had the lowest loading rates. The light color cells running up through the center of the watershed are forested areas. These cells also have the greatest slopes and would have greater sediment yields if they were not colonized with hardwood wetland forest. This evidence supports previous findings that riparian areas are effective management measures for reducing agricultural NPS pollutant loadings. Forested areas constitute over 10% of the land mass yet the sediment yield coming off these areas is lees than 1% of the NPS pollutant loadings.

7.8 Pasture

As can be seen from the ArcView representation of model results, the cells in the NE section of the watershed have lower loading rates. This is largely due to the fact that pasture is grown in this area and the soil is not tilled and exposed to rain events. The presence of dense root matter and foliage coverage prevents the soils from moving off the field and into the stream reaches. Pasture only represents 4% of the pollutant load yet it represents 27% of the land area in the watershed.

7.9 Urban Areas

Urban areas are a moderate source of NPS pollution. Urban land uses constitute 4% of the pollutant loading and 7% of the area in the watershed. Its actual loading of oxygen demanding materials may be greater than what the model predicts. The AnnAGNPS model is primarily for describing soil losses in agricultural areas. The results are rendered in sediment yields. Urban areas use default settings and constituents such as oil and grease, lawn fertilizer, and pet waste are not considered in the model. Urban may compose a greater pollutant load than what is depicted in the model.

7.10 Rice and Soybeans

Soybean and Rice field rotation almost exclusively dominate the agricultural land use in the SW section of the Bayou Queue de Tortue watershed. They represent about 91% of the pollutant loading in the watershed. Of the two, rice produces the greatest annual sediment load to the stream reaches. 85% of the pollutant loading from rice fields originates from the spring discharges after land leveling (mudding in) and seeding. Historical water quality collected over the last 20 years validates the predicted pollutant loadings modeled by AnnAGNPS. Mudding in a rice field involves flooding the field and running disks through the mud and water. Presumably, the disk leveling evens out the high spots and the suspended solids fill in the low spots. Discharges of suspended solids are magnitudes greater during this spring discharge event over the drainages for pesticide/fertilizer applications and harvest that occur during the summer and fall seasons. Root matter anchor sediments in the field and foliage rising through the impounded water provide surface area for microbial decomposition of organic materials and nitrogenous compounds. The summer and fall discharges are relatively clean outflows with very little of the sediments leaving the field. These summer and fall rice field discharges may actually help flush pollutants and improve water quality in the waterways.

7.11 BMP Implementation to Achieve TMDL Goals

This section discusses the modifications to the standard operational practices in 1998 (year watershed landed on 303 (d) TMDL list) to incorporate BMPs that may achieve the prescribed reduction of 60%. The standard practices were discussed above and plugged into the AnnAGNPS model. The results of the AnnAGNPS run can be seen above. Conversely, LDEQ ran the model again with new BMP operational practices. The outcome was a reduction of sediment loads of 62%. The BMPs applied to the adjusted run are discussed below.

7.12 Rice and Soybean BMPs for AnnAGNPS

The key to reducing NPS runoff in the Bayou Queue de Tortue watershed to the levels prescribed in the TMDL is to eliminate the spring discharge of muddy water from the rice fields. The application of rice BMPs will allow farmers to circumvent the muddy discharges that occur during planting season. Instead of "mudding in," the rice farmers can utilize precision leveling techniques. And instead of aerial seeding into flooded fields, farmers can knife in rice seed into a dry seedbed. "Clear field" planting is a recent developing BMP that also allows farmers to plant onto a dry seedbed. These measures will supply methods to eliminate the spring discharge and prevent the discharge of turbid waters that represent the majority of NPS loading occurring into the waterways.

Soybean conservation tillage practices help retain soils during the years of soybean rotation. In 1998, farmers in the watershed tilled the fields 4 times, twice during the spring and twice again during the fall after harvest. By simply eliminating the fall tillage operations and leaving the crop residue on the field, a significant amount of soil is retained on the fields over the winter months when the region experiences heavy and frequent rain events.

7.13 Achieving Goals in the Watershed

A 62% reduction was achieved with the recommended BMPs programmed into the operational input parameters for rice and soybeans. This indicates that a 60% reduction is achievable. As discussed above, the recommended agricultural BMPs include precision leveling and dry seed bedding for rice fields and conservation tillage practices during the soybean growing rotation. LDEQ is recommending that the farmers in the watershed seek government grant sources to purchase precision leveling equipment. Funding for and implementation of precision farming is outlined later in this document.

7.14 Riparian BMPs

Looking closely at both the 1998 and BMP model runs, one can see that forested riparian areas result in the lowest sediment yield. The landuse map, shows that forested areas supply riparian zones along much of the bayou. However, there are still many miles of river that agriculture lands run up right against the bayou-particularly in the upper reaches of the watershed. Riparian zones are proven methods from many sources and a section later in the text is designed to address implementation of riparian zones in the upper reaches of the bayou.

7.15 Revision of AnnAGNPS Model Run

If the recommended BMPs are not achievable, the model accommodates numerous scenarios that can be modified with relative ease. Through the model, all parties involved can review and concur in the operational data being fed in the model and the output from the model. It will benefit the local farmers, state and federal agencies and regional universities to reach agreements on what actions need to be taken to achieve TMDL goals and objectives. If farmers disagree with a certain management plan, then an alternative plan can be tested in the digital representation of the watershed. If the new scenario achieves management goals and all parties agree, then a BMP implementation plan can be revised that can achieve the goals outlined in the TMDLs. The model helps facilitate an open planning process and encourages public involvement. When this happens, the watershed is more likely to be moving toward an environmentally sustainable state.

Figure 7.12 In the Queue de Tortue watershed, the most erodable soils are in close proximity to the stream network. As you can see, the stream bank is completely lacking in riparian habitat and is losing large amounts of soil during rain events.

7.16 Soil Erodibility K-Factor

Soil Erodibility is a soil property that is defined as the ease with which soil is detached by a splash of rainfall or by surface flow or both. Physically, soil erodibility is the change in the soil per unit of applied external force or energy, namely rainfall or overland flow. The most erodable soils are along the bayou and tributaries and the most effective management plan for retaining soils in these areas is the implementation and maintenance of riparian zones. LDEQ is again recommending that riparian areas be installed all along the bayou and tributaries from the edge of the stream at bank full to 100 ft away from the river and streams.

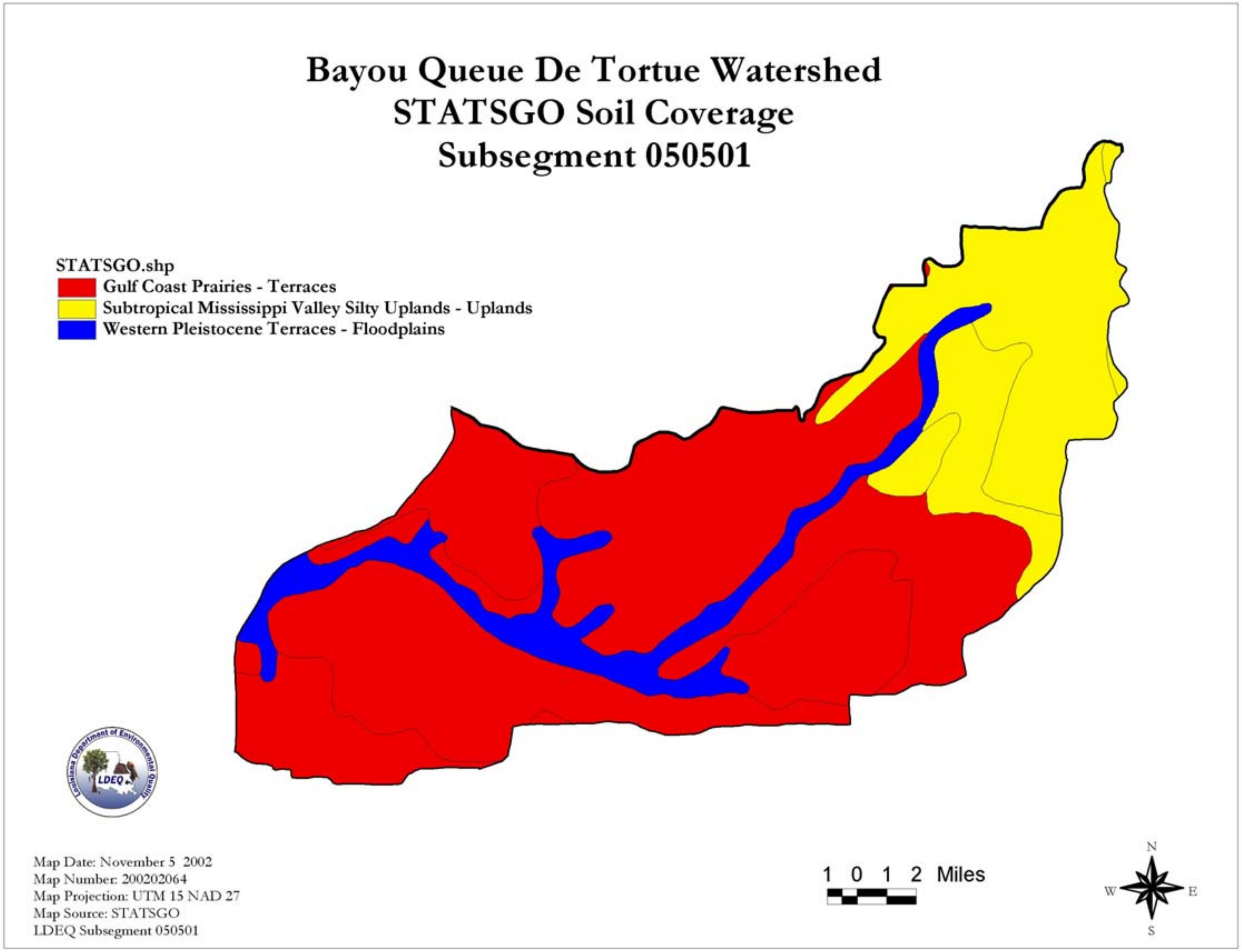


Figure 7.13 STATSCO soils map. There 3 general types soils in the Bayou Queue de Tortue watershed that are predominantly silt loams.

7.17 Achieving Goals: BMP Implementation and Cost Share

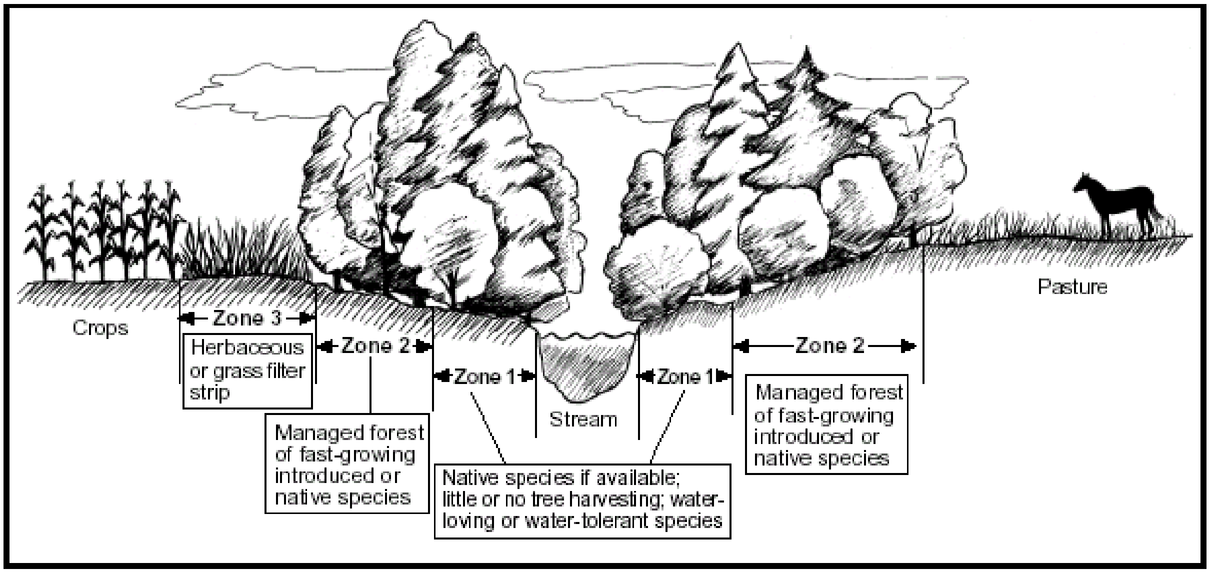
Cost share funding for BMPs is a key element in a successful Implementation Plan. A number of Federal and State funding sources exist for BMP implementation, riparian zones, and land conservation. The LDEQ Non-Point Source group provides USEPA §319(h) funding to assist in implementation of BMPs to address water quality problems on reaches listed on the §303(d) list or which are located within Category I Watersheds as identified under the Unified Watershed Assessment of the Clean Water Action Plan. USEPA §319(h) funds were utilized to sponsor the cost sharing and monitoring projects discussed above. These monies are available to all private, for profit and nonprofit organizations that are authenticated legal entities, or governmental jurisdictions including: cities, counties, tribal entities, Federal agencies, or agencies of the State. Proposals are submitted by applicants through a Request for Proposal (RFP) process and require a non-federal match of 40% of the total project cost consisting of funds and/or in-kind services. Further information on funding from the Clean Water Act §319 (h) can be found at the LDEQ web site at: www.deq.state.la.us.

7.18 Other Federal and State funds

The U.S. Department of Agriculture (USDA) offers landowners financial, technical, and educational assistance to implement conservation practices on privately owned land to reduce soil erosion, improve water quality, and enhance crop land, forest land, wetlands, grazing lands and wildlife habitat. One of these programs is the Conservation Reserve Program (CRP). It is designed to encourage farmers to convert highly erosive cropland to vegetative cover, such as native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive annual rental payment for the term of the multi-year contract. The Conservation Reserve Enhancement Program (CREP) combines the resources of the CRP program with that of the State government. This program focuses on NPS pollution and water and habitat restoration. The Environmental Quality Incentives Program (EQUIP) is another source of funding available to the farmers for conservation practices. These are a few of the State and Federal funding sources available to agricultural landowners that will help with the cost of reducing NPS run-off from their fields.

7.19 Achieving Goals: Riparian Zones

Riparian areas can be defined in numerous ways. The USDA – Forest Service defines it as "the aquatic ecosystem and the portions of the adjacent terrestrial ecosystem that directly affect or are affected by the aquatic environment. This includes streams, rivers, lakes, and bays and their adjacent side channels, flood plain, and wetlands. In specific cases, the riparian area may also include a portion of the hill-slope that directly serves as streamside habitat for wildlife." Because of landscape position, the riparian zone is ultimately linked to the stream channel and its aquatic ecosystems as well as the upland ecosystems. As a result they play a critical role in the hydrology of watersheds. Their typically long and narrow nature, along with their unique physical and biological processes, allow riparian zones to act as strategic buffers between upland and aquatic ecosystems. Although riparian zones may occupy as little as 1% of the land area of a watershed, these ecosystems are among the most productive in the landscape. Some of their most important functions are filtering and retaining sediment; immobilizing , storing, and transforming chemical inputs from uplands; controlling stream environments and morphology; controlling aquatic and terrestrial habitats; providing water storage and recharge of subsurface aquifers; and, reducing floods.



A riparian forest buffer includes zone 1, the area closest to the waterbody or course, and zone 2, the area adjacent to and up gradient of zone 1. Trees and shrubs in zone 1 provide important wildlife habitat, litter fall for aquatic organisms, and shading to lower water temperature. This zone helps stabilize streambanks and shorelines. Trees and shrubs in zone 2 (along with zone 1) intercept sediment, nutrients, pesticides, and other pollutants in surface and subsurface water flows. Zone 2 can be managed to provide timber, wood fiber, and horticultural products. A third zone, zone 3, is established if periodic and excessive water flows, erosion, and sediment from upslope fields or tracts are anticipated. Zone 3 is generally of herbaceous plants or grass and a diversion or terrace, if needed. This zone provides a "first defense" to assure proper functioning of zones 1 and 2.

Figure 7.14 Above is an illustration of the 3 riparian zones

7.20 Riparian Forest Buffers have three distinct zones

Zone 1 is a 5m wide strip of undisturbed mature trees that begins at the edge of the stream bank and provides the final filter for materials moving through the buffer. The purpose of this zone is to create an undisturbed, stable ecosystem that provides bank stability, an environment for dissolved soil water nutrients to interact with the "living filter" including plants that shade the stream stabilizing water temperatures and provide both fine particulate organic matter and large woody debris to the stream. Over mature trees are valued as they provide large woody debris for the stream. Logging equipment is excluded except at designated stream crossings. Likewise, grazing is excluded for this zone.

Zone 2 is adjacent to Zone 1 and is a zone of trees at least 18m wide and managed to provide maximum infiltration of surface runoff and nutrient uptake and storage while also providing organic matter for microbial processing of agrochemicals. The purpose of this zone is to provide the necessary contact time for biological processes associated with microbial activity and to provide plant uptake to removed NPS pollutants from the soil water column. Multiple-use management for timber and wildlife can be compatible with NPS removal.

Zone 3 is a zone of grazed or ungrazed grass, a minimum of 6m wide, which converts concentrated flow from the upland to sheet flow, either naturally or by the use of structures. This zone filters sediment from the sheet flow and causes the water and agrochemicals to infiltrate into the biologically active rooting zone where nutrient uptake and microbial processing occurs. The zone is composed of grasses and forbs that must be removed to provide effective nutrient sequestering. Grazing is allowed when earthen control structures are not damaged. Occasional reshaping of structures and removal of accumulated sediment may be necessary to maintain proper function

7.21 CONSERVATION RESERVE PROGRAM (CRP)

The Conservation Reserve Program (CRP) provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with Federal, State, and tribal environmental laws, and encourages environmental enhancement. The program is funded through the Commodity Credit Corporation (CCC). CRP is administered by the Farm Service Agency, with NRCS providing technical land eligibility determinations, Environmental Benefit Index Scoring, and conservation planning.

The Conservation Reserve Program reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodable cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish the vegetative cover practices. Currently, CRP is financially the most lucrative program the USDA offers to eligible farmers and ranchers with a 50% cost-share, an additional 40% practice incentive payment, a $10/acre X length of contract signing bonus, as well as an annual rental rate of approximately $30/acre.

7.22 ENVIRONMENTAL QUALITY INCENTIVES PROGRAM (EQIP)

The Environmental Quality Incentives Program (EQIP) was established in the 1996 Farm Bill to provide a voluntary conservation program for farmers and ranchers who face serious threats to soil, water, and related natural resources. Nationally, it provides educational assistance primarily in designated priority areas. About half of the program is targeted towards livestock related natural resource concerns and the remainder goes to other significant conservation concerns.

EQIP offers 5-to 10-year contracts that provide incentive payments and cost-sharing for conservation practices called for in the site-specific conservation plan. All EQIP activities must be carried out according to a conservation plan that is site specific for each farm or ranch. Producers can develop these plans with help from the NRCS or other service providers.

Cost-sharing may pay up to 75% of the costs of certain conservation practices such as grassed waterways, filter strips, manure management facilities, capping abandoned wells, and other practices important to improving and maintaining the health of natural resources in the area. Incentive payments may be made to encourage a producer to perform land management practices such as nutrient management , manure management, integrated pest management, irrigation water management, and wildlife habitat management. Total cost-share and incentive payments are limited to $10,000 per person/year and $50,000 for the length of the contract. These payments may be provided for up to three years.

7.23 Wildlife Habitat Incentives Program (WHIP)

The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private lands. It provides both technical assistance and cost-share payments to help establish and improve fish and wildlife habitat.

The objectives of WHIP are to implement parts of the eligible participant's conservation plan that create and enhance wildlife habitat, provide program participants informational and educational support regarding wildlife habitat needs, and foster a positive public attitude towards wildlife, wildlife habitat, and land stewardship. This will be accomplished by participants entering into a WHIP agreement to provide financial assistance in the form of cost-share payments to enhance habitat on eligible land.

Cost-share assistance is provided in 5-to 10-year agreements provided the landowner agrees to install and maintain the WHIP practices and allow the NRCS or its agent access to monitor the effectiveness of the practices. In return, the USDA agrees to provide technical assistance and pay up to 75% of the cost of installing the wildlife habitat practices.

7.24 TMDL Monitoring Schedule

As LDEQ continues to monitor the water bodies across the state on the 5-year basin cyclic program, annual progress made in BMP implementation will be documented and reported to EPA, the NPS Interagency Committee and the general public through LDEQ's website. The first cycle of water quality monitoring will utilize the data collected to develop the TMDL and devise the watershed restoration action strategy. The second cycle will provide a baseline data for TMDL Implementation Plan and third cycle will determine whether the Implementation Plan has been effective in reducing nonpoint source pollutants and improving water quality within the water body. If this third cycle of water quality monitoring does not indicate a significant improvement in the implementation of agricultural best management practices within the watersheds on the 1998 303(d) list, then LDEQ and the cooperating federal and state agencies will determine whether back-up authorities are necessary to achieve the BMP implementation required to reduce nonpoint sources of pollution and improve water quality.

7.25 Future Objectives and Milestones: The Master Farmer Program

The objective is to get as many of the landowners in the Bayou Queue de Tortue watershed to implement BMPs as possible and to restore the designated uses back to the bayou in 10-15 years. As outlined in the TMDL, it will require a 50% reduction in NPS pollution. Restoration will require the implementation of BMPs, not only in the two subwatersheds mentioned above, but throughout the watershed. LSU AgCenter is promoting the Master Farmer Program to help farmers address environmental stewardship through voluntary, effective, and economically achievable BMPs. The program will be implemented through a multi-agency/organization partnership including the Louisiana Farm Bureau (LFBF), the Natural Resources Conservation Service (NRCS), the Louisiana Cooperative Extension Service (LCES), USDA-Agriculture Research Service (ARS), LDEQ, and agricultural producers.

The Master Farmer Program will have three components: environmental stewardship, agricultural production, and farm management. The environmental stewardship component will have three phases. Phase I will focus on the environmental education and crop-specific BMPs and their implementation. Phase II of the environmental component will include in-the-field viewing of implemented BMPs on "Model Farms." Farmers will be able to see farms that document BMP effectiveness in reducing sediment runoff. Phase III will involve the development and implementation of farm-specific, comprehensive conservation plans by the participants. A member must participate in all three phases in order to gain program status.

This program can help to initiate and distribute the use of BMPs throughout the Queue de Tortue watershed. The members will set an example for the rest of the agricultural community. They will work closely with scientists and other Master Farmers to identify potential problem areas in the watershed. They will receive information on new and innovative ways to reduce soil and nutrient loss from their fields. They will be kept abreast of the water quality monitoring occurring in the watershed and alerted of any degradation or improvements. The Master Farmer Program will allow stakeholder agencies to observe the acceptance of BMPs throughout the watershed and they will help LDEQ observers track the implementation of soil management plans.

The solutions to controlling runoff will require the joint efforts of agriculture producers, landowners, government, private citizens and private organizations working together. The Louisiana Cooperative Extension Service (LCES) and Louisiana State University (LSU) AgCenter conducted a commodity-specific BMP review. These reviews were conducted through a multi-agency/organization partnership made up of research and extension scientists, the Louisiana Farm Bureau (LFBF), the Natural Resources Conservation Service (NRCS), the LDEQ, USDA-Agriculture Research Service (ARS), and agriculture producers.

8.0 URBAN BEST MANAGEMENT PRACTICES

Figure 8.1 Silt fences are one of the BMPs for construction sites in urban areas.

8.1 INTRODUCTION

Phase I and Phase II of Urban Storm Water Regulations will not be enforceable in the Queue de Tortue watershed since there are no urban areas in the watershed with populations greater than 50,000. Water quality goals in urban areas of the watershed are virtually the same as in other types of land-use categories, but they are often more difficult to reach. The types of pollutants associated with the low dissolved oxygen concentration were sediments, nutrients, and organic enrichment. These pollutants come from construction sites, lawns and golf courses, and industrial parks. Oil and grease and metals also continue to be included in the array of pollutants associated with urban nonpoint source pollution. Oil and grease come from streets and parking lots and can also from people who change the oil in the family automobile and dispose of the used oil down the storm drain. In order to address the long-term water quality goals of restoring the designated uses for urban stream, the types of pollutants defined will need to be reduced.

8.2 BMPs to Reduce Urban NPS Runoff

Citizens and city planners have a wide variety of urban BMPs to choose from to address the many different sources of NPS pollution in urban settings. A list of Stormwater BMPs are available that are LDEQ approved methods for construction sites, parking lots and other impervious surfaces, industrial parks, residential homes and lawns, and automobile service centers. Currently, there are no educational programs or any systematic reduction program for Urban NPS pollution in place in the Bayou Queue de Tortue watershed.

8.3 Storm Drain Stenciling and Marker Program

Louisiana's NPS Program has had a storm drain stenciling program since 1991, which has proven to be very popular and rather extensively implemented in cities and smaller communities across the state. In 1998, LDEQ ordered storm drain markers, which are basically a plastic decal that can be glued to the storm drain. It has the message, "Dump No Waste. Drains to Stream", and should be a more permanent way to mark the storm drain with a water quality message. These are available through the Nonpoint Source Unit at LDEQ.

8.4 Oil and Grease

Oil and grease from parking lots and streets can be controlled with infiltration trenches, grassed swales or wetlands and filters in storm drains. Storm drain stenciling or marking programs can be one method to reduce the amount of used oil down storm drains. These types of programs combined with a better understanding of how and where used oil and antifreeze should be disposed of can reduce the amount of these chemicals in urban streams.

8.5 Urban Educational Materials

Educational materials such as brochures, fact cards and pamphlets are an important component to any watershed or statewide educational program. People need to clearly understand what the water quality issue is and how their activities contribute to the pollution problem. The educational materials that LDEQ has designed have been very popular with both adults and children and have been widely distributed through many workshops, schools, conferences, and other public events across the state. The messages are simple, but clearly stated so that each individual can understand which type of actions he can take to reduce nonpoint source pollution from his home, lawn, or neighborhood. Examples of the message on some of these materials have been included here and copies can be obtained by contacting the Louisiana Department of Environmental Quality (LDEQ).

8.6 Urban Educational Video

In 1999, LDEQ decided to develop an educational video on urban nonpoint source pollution that could be distributed to the townships in the watershed. The objective of the video is to highlight actions that some of the cities and communities across the state have taken to address their urban nonpoint source pollution. In order for these management measures to be sufficiently implemented to reduce and control urban nonpoint source pollutants, federal, state and local authorities will need to be utilized.

8.7 Future Objectives and Milestones

The future objectives and milestones for the urban nonpoint source program are to continue to educate city officials, engineers, planners, developers, and the general public about urban nonpoint source pollution. This educational program will rely on materials and information already developed, but will continue to build on new information that has been successfully utilized in other states and cities. Information on home lawn chemicals, urban forestry, sustainable and cluster development, urban wetland detention areas, and many other technologies will continue to be provided to the cities across the state. In addition to providing educational materials, LDEQ will work with other state and local governments to form local nonpoint source working groups or coalitions where the specific nonpoint source problems can be identified and best management practices (BMPs) implemented to reduce and control them.

8.8 Achieving Goals

Addressing urban nonpoint source pollution is difficult since there is not a federal or state infrastructure for urban areas like there is for agricultural and forested areas of the state. However, there are many things that can be done to address urban nonpoint pollution issues. These activities include: storm drain stenciling and marking programs that can be disseminated into the local community; urban nonpoint source educational materials that can be distributed through parish and city offices; an urban educational video that highlights the pollution problems and pollution control methods that can be implemented to reduce these pollutants; an urban educational program developed and implemented through statewide organizations such as the Louisiana Cooperative Extension Service, the Office of Soil and Water Conservation, Louisiana Department of Natural Resources/Coastal Management Division, Natural Resources Conservation Service, Resource Conservation and Development Districts, Urban Forestry Council, Municipal Associations, etc. develop and/or implement local ordinances that require implementation of urban best management practices; and encourage and track the use of checklists such as Pesticide Application Checklist, Auto Repair Checklist, and the Construction Site checklist as a method to track BMP implementation.

8.9 Urban Program Tracking and Evaluation

In order for progress to be monitored and evaluated, it is important to track the level and also the pace of implementation of the goals and objectives outlined within this document. LDEQ reports on progress made in all of the areas of the NPS Management Program to the NPS Interagency Committee. This is done through quarterly newsletters and meetings and also through LDEQ’s web-site. Progress is reported on all of the goals and milestones outlined within the NPS Management Plan to EPA Region 6 on an annual basis. Semi-annual reports highlight project activities and progress made in specific areas of the program.

9.0 HYDROMODIFICATION BEST MANAGEMENT PRACTICES

FIGURE 9.1 This stream reach has a multitude of problems resulting from hydromodification. It has been straightened to accommodate increased flow, the stream bank vegetation has been destroyed, and the system has been dredged to accommodate temporary transportation needs.

9.1 INTRODUCTION

Hydromodification can cause a multitude of problems to a river ecosystem. Dredging typically increases the turbidity in the water body by disturbing the bottom sediments, which have accumulated over an extended period of time. Dredging causes a re-suspension, re-dissolution, or leaching of these materials. The concern that arises is that toxic substances or heavy metals may be reintroduced to the water column where they can adversely affect plant and animal life and other beneficial uses of the water body. Within Louisiana, the re-suspension of the benthic sediments often results in the organic material attached or stored with the sediments also being suspended within the water column, adding to the oxygen depletion of the bayou or stream.

There are a number of methods used to perform channel modifications. These include clearing and snagging, modifications of existing channels, and new channel excavation. Channel excavation is used to increase the hydraulic conveyance. This can be done by widening and deepening the channel or by eliminating meanders. The types of water quality problems associated with these activities include vegetative and soil cover disturbance during construction, increased scour due to increased water velocities, and increased water temperature if overhanging vegetation is removed. Further increasing velocities increase the reach over which organic pollutants can exert an oxygen demand.

Other Impacts - Hydrologic modifications can generate other impacts, which can be temporary or exist for the life of the structure. These can include the following:

- Land to be inundated to form an impoundment is removed from use;
- Sudden suspension and resettling of sediments can affect fish spawning areas and attached aquatic life;
- Air, water and noise pollution occur during construction;
- Ecological systems are disrupted during construction, in the case of impoundments, terrestrial habitats are destroyed;
- Development of drainage channels may encourage the conversion of wild areas to human-dominated land use;
- Changing the temperature and flow regime of a river by impoundment or by channel alignment may alter the populations of flora and fauna;
- Channelization can be accompanied by accelerated bank erosion;
- Dredging activities can disrupt bottom dwellers; if dredging is periodic, populations may not be able to reestablish themselves;
- Maintenance of navigation channels may adversely impact wetlands.

When stream bank vegetation, such as trees are removed from the edge of the stream, it can have several affects on the water quality. If the trees provided shading to the stream, then their removal can result in increased stream temperature and decreased dissolved oxygen concentrations. If the trees were providing organic input to the stream by leaf material and woody debris, then removing the trees can result in a decreased food source for macro-invertebrates and woody debris for fish habitat. This woody debris is an important component of fish habitat in bayous and streams of Louisiana, since bayous often do not have pools and riffles in them. Pools and riffles develop around the woody debris that falls into the stream or bayou and provide good habitat for fish and macro-invertebrates. Removing trees from the streambank can also result in increased soil erosion from steep banks if proper stabilization methods are not utilized. This increased erosion can result in higher concentrations of suspended solids in the stream as sediment is washed from the bank during storm water events. The increased sediment in the stream can lead to turbidity or murky water that has the potential to affect the designated use for fish and wildlife propagation.

When a water body is straightened, the hydrologic characteristics are altered which can affect its ability to re-aerate itself. In the Mermentau River Basin, hydromodification has created areas called “stretch lakes” in many of its bayous. These long, wide segments of the bayou begin to function more like a lake than a flowing stream. Bayous are naturally slow-moving water bodies that transport large amounts of sediment and organic material. As the bayou is channelized and a stretch lake is formed, the pollutants settle out and are deposited on the bottom similar to a detention basin. Once these stretch lakes are formed, it is very difficult to flush the pollutants out of the system because the flow has been reduced to such an extent that the pollutants are no longer transported but are deposited in this wide, deep portion of the bayou. These segments of the bayou typically exhibit almost no flow and have very low dissolved oxygen concentrations.

Therefore through hydromodifcation, often both the streambank and the stream channel are altered. These alterations affect the dynamics of the stream or bayou in many ways, primarily changing the energy of the stream, which affects its flow and its ability to transport pollutants and re-oxygenate itself. Urban streams are often channelized so that they can transport the water more quickly, thereby reducing flooding. Through this process the energy of the stream typically increases and transports the water and the associated pollutant load downstream where it is deposited in a lake, estuary or wetland. If the stream is converted to a channel that has a homogenous substrate, this can also affect fishery populations by decreasing habitat diversity. The combined effect of stream channel alteration and removal of riparian vegetation along the streambank often lead to lower dissolved oxygen concentration and reduced species diversity of fish and macro-invertebrates.

9.2 ACHIEVING GOALS

The water quality goals related to hydromodification are to reduce the impact that physical alteration of the water body has on the temperature and the dissolved oxygen. These two water quality parameters are utilized to determine if the fish and wildlife propagation use is being met or protected. The programmatic goal is to either reduce the frequency and extensiveness of hydromodification in Louisiana's water bodies or to implement the types of best management practices included within this document in order to reduce the impacts that hydromodification has on the fish and wildlife habitat. If steps are taken to implement best management practices (BMPs) on agricultural land and at construction sites, then less sediment should get into the water. If urban planning for new developments includes detention basins and vegetated wetlands to trap sediments and organic material, then fewer pollutants will be delivered to the water body. If the water body has a lower concentration of sediment, nutrients, and organic matter to transport, then it should be able to retain its carrying capacity for water more efficiently. This should result in more effective drainage and less frequent dredging. Less frequent dredging should result in improved aquatic habitat for fish and macro-invertebrate populations and improve the designated use for fish and wildlife propagation.

Through the reduction of sediment and other pollutants associated with these three land-use categories, the need for channelization of streams, bayous and rivers should be reduced. There also needs to be an extensive educational program for police juries, city engineers and parish drainage boards on innovative ways to manage streams and drainage systems at the local level. Most of them spend a great deal of their time planning projects and hearing complaints to alleviate drainage problems. The most effective way to address these problems is through a watershed focus instead of working on the water body in a piece-meal fashion that never examines it as a total system. Through recent work in Tangipahoa Parish, the Louisiana Department of Environmental Quality (LDEQ) worked with the Parish Drainage District and University of Southeastern Louisiana on a streambank vegetation management project. This project has resulted in a manual that instructs parish drainage boards and police juries on the steps that can be taken to manage vegetation with less pesticides and disturbance of the steam bank. This manual will be made available to each of the 64 parishes across the state as one educational tool to illustrate the importance of stream banks in maintaining and improving water quality.

9.3 Future Objectives and Milestones

A new handbook on Stream Corridor Restoration that was compiled through a cooperative effort of fifteen federal agencies contains step-by-step guidelines on managing streams from a watershed approach. For a short-term goal, the NPS Unit will work with USDA on a series of workshops where these principles are explained and copies of the workbook are provided to the local governments. These workshops can be held in areas where urban development or agricultural production is placing additional stress on the bayous and streams. The NRCS is trained to implement many of the principles within this workbook. LDEQ will work with NRCS to disseminate these watershed restoration concepts in areas of the state where hydromodification has affected the physical characteristics of the stream. Educational workshops, demonstration projects that illustrate the streambank restoration techniques and technical reference manuals can all be utilized as methods to reduce the impact that hydromodification has on streams and bayous in Louisiana.

- Work with USDA on hosting a workshop on Stream Corridor Restoration (short-term);
- Develop partnerships with local drainage boards, police juries and conservation districts to implement these restoration strategies within watersheds that have been impaired by streambank and channel alteration (short-term);
- Implement a project where these restoration strategies are utilized as a method to improve aquatic habitat (short-term);
- Host field tours to illustrate the principles utilized at the project site and educate parish and city officials on the benefits of the techniques (short-term);
- Develop an educational video and brochure to accompany the workbook so that other districts, parish and city officials can learn to utilize these restoration strategies (short-term);
- Track the implementation rate of these methods through Local Soil and Water Conservation Districts, NRCS and other local entities (short-term);
- Measure water quality improvement through improved habitat, biological communities, and chemistry of the water in areas where the restoration techniques have been implemented (short-term);
- Report on progress made in this programmatic area to EPA on an annual basis (short-term);
- Determine if additional steps are necessary to reduce the water quality impact that hydromodification has on water bodies within Louisiana and work with the Corp of Engineers, the Local drainage Boards and the Police Juries to implement these steps within each of the drainage improvement projects (long-term);
- Track whether these steps have been successful in improving water quality and reducing nonpoint source pollution that results from hydromodification projects (long-term).
- Utilize the federal, state and local regulations, laws and ordinances that are applicable to requiring that best management practices be incorporated into 404 and 401 projects, in

order to reduce the impact that hydromodification has on the state's water bodies (long-term);

- The LDNR/CMD will coordinate its program with the LDEQ program, and will track the progress and report to NOAA (short-term);
- LDEQ and LDNR/CMD will coordinate education and instructional efforts through the Local Coastal Program, when this approach is most functional (short-term).

The goals of the Statewide Hydromodification Education Program are to incorporate nonpoint source water quality goals and objectives into state, federal and local programs that manage stream channels and stream banks. Louisiana Department of Environmental Quality has committed to the previous goals and objectives in order to improve the quality of the streambank and aquatic habitats along the state's water bodies. Since all of the water bodies on the state's 1998 303(d) list will have TMDLs developed within the next 10 years, the hydromodification issues will be included within the watershed restoration action strategies and implementation plans. These steps are consistent with the goals and objectives of the section of the NPS Management Program and are expected to result in water quality improvement within the next 10-15 years.

9.4 Program Tracking and Evaluation

Tracking of the changes that are made in the methods used to manage streams at the local level will need to be done at the local and the state level. The parish drainage boards and police juries often have the authorities for these types of projects. The NRCS and the Local SWCD are also local entities that can assist with tracking the changes that result from these restoration techniques being utilized more frequently. LDEQ will work with these local entities to determine a method that can effectively track improvements made as a result of the activities outlined here.

Tracking the water quality improvements that result from increased implementation of hydromodification management practices is the responsibility of LDEQ. Through the basin cyclic water quality monitoring program, watersheds will be sampled every five years for stream chemistry. This program can report on the long-term changes that result in the stream from improved methods of streambank protection and watershed management. In order to determine the level of habitat improvement that results from these restoration techniques, LDEQ will need to conduct baseline habitat assessment, which include macro-invertebrate and fish. Follow-up assessments will determine whether these streambank and stream channel protection methods have resulted in measurable water quality and habitat improvements. LDNR/CMD will assist in tracking and evaluation by providing data from the permit/mitigation database on hydromodification/restoration activities that require Coastal Use Permits in the coastal zone.

10.0 HOME SEWERAGE BEST MANAGEMENT PRACTICES

10.1 INTRODUCTION

Ground and surface water pollution are major considerations when on-site sewerage treatment systems are used. Sewerage treatment and disposal systems should be designed and operated in a manner, which prevents the degradation of ground and surface water quality. Septic tank systems used in undersized lots or where soils are unsuitable for proper treatment of wastewater are subject to undesirable conditions such as widespread saturation of the soil and malfunction of the treatment system. Malfunctioning systems result in sewerage leaching into ground water and into roadside ditches, contaminating surface water.

Septic tank systems must be designed so that they are compatible with the geological attributes of the area. If the ground water level is high (less than 4 feet below the surface) or if the soil is extremely permeable, the soil will not be effective in removing pollutants and the ground water may become contaminated, resulting in a public health hazard. Many diseases, including infectious hepatitis, typhoid fever, dysentery, and some forms of diarrhea are caused by water and food contaminated with sewerage and can easily be spread by flies.

One of the main problems with using conventional septic tank soil absorption systems in Louisiana is that 87 percent of the soil associations in Louisiana are considered inadequate for conventional septic tank systems as determined from the Soil Limitation Ratings for Sanitary Facilities (LDOTD, 1981). Another major component to the pollution caused by septic tank systems is inadequate enforcement of the State Sanitary Code. The State of Louisiana currently has regulations concerning private sewerage disposal systems under the State Sanitary Code (LHHRA, 1974) and the Department of Health and Hospitals (DHH) (LR, 1980). A majority of the sanitarians expressed concern that there is control over new septic tank systems being installed, but there are extensive problems with monitoring the maintenance of existing systems.

10.2 ACHIEVING GOALS: EDUCATIONAL PROGRAMS

There are several issues or program activities that need to be addressed to reduce the water quality problems that are associated with home sewerage systems. One of the most important steps is continued education of the homeowner about how his/her home sewerage system works. Most homeowners have no idea how to maintain their home sewerage system for maximum efficiency. A second aspect of the statewide program that needs to be addressed is the lack of inspection of home sewerage systems. The local parish sanitarian office typically does not have sufficient staff to inspect all of the systems across the parish. Even if the system was inspected, it is often difficult to force an action to correct the problem. LDEQ and LDHH are working together to ensure that more education about the problems that these systems cause to water quality across the state will result in more stringent regulations on maintenance of new and existing home sewerage systems.

LDEQ has worked with the Louisiana Department of Health and Hospitals on statewide educational programs aimed at reducing fecal coliform bacteria and nutrients from home sewerage systems. An educational brochure and video were produced that focused on the various types of home sewerage systems that are approved for use in Louisiana. Each type of system was explained along with maintenance requirements recommended to keep the system functioning properly. A maintenance checklist was also included so that the homeowner could keep a record of the steps that had been taken to clean the system out or to have it repaired.

The educational video has been reproduced and distributed across the state in parish offices of the Department of Health and Hospitals and the Louisiana Cooperative Extension Service. These materials are important components for the statewide educational program on home sewerage systems.

The primary goals of the Home Sewerage Statewide Educational Program are to continue to work with the Department of Health and Hospitals and parish governments on more effective inspection programs to ensure that the regulations, which require home sewerage systems to function properly are enforced. Implementation of the short term and long term objectives described above should result in an increased level of compliance across the state and a > 50% reduction of fecal coliform problems from home sewerage systems during the next 10-15 years.

10.3 Home Sewerage Systems Approved for use in Louisiana

10.3.1 Septic Systems

A septic tank is a watertight tank constructed of steel, concrete or other approved materials in which the suspended solids of sewerage settle out and are largely changed into liquids or gases by microbial degradation. The remaining residue in the tank is a black semi-liquid sludge that must be removed periodically from the tank. Although relatively few disease organisms should be present in the sludge material, precautions should be taken in cleaning the tank and the sludge material safely disposed. Cleaning and disposal of sludge material from septic tanks can be provided by commercial services. These services are controlled by a permit system, required by local parish health units in accordance with Chapter 13 of the State Sanitary Code.

A series of single compartment septic tank systems or a multiple compartment septic tank system has proven to be more effective than the individual septic tank system, but the individual septic tank system is still acceptable. Information on the velocities of flow through the system and the types of tees and baffles required for the inlet and outlet valves are included within the description of septic tank systems. Estimates of capacities and size for a system are also included, with recommendations for the types of materials that should be utilized in their construction. Recommendations are also made for inspection and cleaning of the systems with the optimum time period being every two to five years, although the average period between cleaning was estimated to be between eight and ten years.

10.3.2 Septic Tank Effluent

Although many people believe that discharge waters from a septic tank system are clean and pure, this is not the case. The effluent of the liquid discharged from a septic tank system is classified as primary treatment, usually being foul and potentially dangerous, often containing disease-causing bacteria. Therefore discharge of septic tank effluent are not allowed in street gutters, surface ditches, or streams, according to regulations in the Louisiana State Sanitary Code. The method recommended for treatment of septic tank effluent is a soil absorption trench system. If the absorption trench is not possible due to poor soil or drainage conditions, then a small oxidation pond or a sand filter bed can also be utilized for secondary treatment of septic tank effluent.

10.4 Program Tracking and Evaluation

Tracking installation and maintenance of home sewerage systems is a labor intensive job that requires sufficient staff to conduct inspections. The Nonpoint Source Unit will work with the Parish Sanitarian Office in watersheds across the state where home sewerage systems have been identified as contributing to use impairment. Through this partnership, LDEQ could provide federal funds to expand their present staff capabilities for home sewerage system inspection for a three-year period. DHH staff would inspect existing home sewerage systems to determine if they function properly and work with the homeowner to correct any problems that are identified. These staff would also assist in establishing a parish-wide database to record the inspections and track progress in correcting problems that have been identified through the inspections. LDEQ will report on the results of this project through semi-annual and annual reports that are submitted to EPA.

- Implement the home sewer inspection and tracking program (short-term);
- Work with the Parish Health Sanitarian Office to determine the extensiveness of the inspections and a timeline to complete them (short-term);
- Assist the parish office in establishing a computer tracking system that identifies where inspections have been made, problems identified, actions taken and timeline to correct the problems (short-term);
- Utilize federal funds to support this pilot project through additional staff for conducting the inspections, establishing the computer tracking system and working with the homeowner on correcting the problems that were identified through the inspection process (short-term);
- Link results of parish-wide sewer inspection and tracking program with in-stream water quality improvements (short and long-term);
- Report results of the pilot project to EPA on a semi-annual and annual basis (short-term);
- Submit a final report that summarizes the results of the project to EPA (short-term);
- Determine if the project was successful and transfer to other priority watersheds if it proves to be an effective mechanism to reduce the fecal coliform problems associated with home sewerage systems (long-term);
- Work with LDHH to determine if this program can become established as a statewide program that is supported through a combination of federal and state funds (long-term).

11.0 AGRICULTURE BMP REFERENCES

Baffaut, C., Nearing, M.A., Nicks, A.D. 1995. Impact of Cligen Parameters on Wepp-Predicted Average Annual Soil Loss. Transactions of the ASAE. American Society of Agricultural Engineers.Vol.39(2): pp.447-457.

Bagwell, R.D., Holman, M.E., Padgett, G.B. 1999. Harvest Aids for Cotton In Louisiana. Louisiana State University Agricultural Center. Pub.2291(5.5M)

Baldwin, J.L., Boethel, D.J., Leonard, Roger. 2000. Control Soybean Insects 2000. Louisiana State University Ag. Center Research and Extension.

Baldwin, J.L., Riley, T. J., Leonard, Roger. 1999.Managing Corn and Grain Sorghum Insect Pests 2000. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Ball-Coelho, B., Tissen, H., Stewart, J.W.B., Salecdo, I.H., Sampaio, V.S.B. 1993. Residue management Effects on Sugarcane Yield and Soil Properties in Northeastern Brazil. Agronomy Journal. Vol. 85. Pp.1004-1008.

Barnett, J., Boquet, D., Leonard, R., Wolcott, M. 2000. Cotton Varieties for Louisiana 2000. Louisiana State University Agricultural Center. Pub.2135(8M).

Bengtson, R.L., Selim, H.M., Ricaud, R. 1997. Water Quality from Sugarcane Production on Alluvial Soils. Transactions of the ASAE. American Society of Agricultural Engineers. Vol.4(5) pp.1331-1336.

Berger, W.C. Jr., Carney, J., Duerr, R.K. 1999. Bayou Queue de Tortue Watershed TDML for Dissolved Oxygen Including Eight Point Source Wasteload Allocations and A Watershed Nonpoint Source Load Allocations.Vol.1&2. Subsegment 0502.

Board, J.E., Harville, B.G. 1993. Soybean Yield Component Responses to a Light Interception Gradient during the Reproductive Period. Crop Science Vol.33(4) p.772-777.

Bollich, P.K., Feagley, S.E., Gambrell, R.P., Groth, D.E. 1996. Mermentau River basin Nonpoint Source Project. Phase II Proposal. Influence of Tillage Practices on Rice Field Floodwater Quality.

Brown, L.C., Norton, L.D. Surface Residue Effects on Soil Erosion from Ridges of Different Soils and Formation. Transactions of the ASAE. American Society of Agricultural Engineers. Vol.37(5) pp.1515-1524.

Brown, Lester. Chaney, C.R. 1999. 1999 Cool-Season Pasture and Forage Varieties. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Brunson, Martin. 1989. Evaluation Of Rice Varieties for Double Cropping Crawfish and Rice in Southwest Louisiana. Louisiana Agricultural Experiment Station. Louisiana State University Agricultural Center.

Bui, E.N., Box, J.E. Jr. 1993. Growing Corn Root Effects on Interrill Soil Erosion. Soil Science American Journal. Vol.57 pp.1066-1070.

Caffey, H.R., Tipton, K.W. 1996. Insect Pest Management. Conservation Tillage systems for Energy Reduction. Louisiana Department of Natural Resources.Pub.8907(5M)

Caffey, Rouse H., 1986.Growing Corn in Louisiana. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Cartrer, R., Andries, J., Coburn, G. 1998. Cotton Insect Control Recommendations for the Red River Valley During 1998.Louisiana State University Agricultural Center. Pub. 2698.(2M).

Dickey, C.E., Shelton, D.P., Jasa, P.J., Peterson, T.R. 1984.Erosion from Tillage Systems Used in Soybean and Corn Residues. Transactions of the ASAE. American Society of Agricultural Engineers. Vol.28(4) pp.1124-1129.

Faw, W.F. 1999. Sugarcane Planting Recommendations and Suggestions. Louisiana State University Agricultural Center. Louisiana Cooperative Extension Service.

Funderburg, E. R., Burch, T.A. 1994. Cotton Fertilization. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Funderburg, E. R., Morrison, W.C. 1998. Corn Fertilization. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Funderburg, E.R., Bollich, Pat. 2000. Fertilization of Louisiana Rice. Louisiana State University Agricultural Center. Louisiana Agricultural Experiment Station.

Funderburg, E.R., Faw, W.F. 1995. Sugarcane Fertilization. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Funderburg, E.R., Tidwell, E. K. 1998. Pasture Fertilization in Louisiana. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Funderburg, Eddie. 1995. Soil Fertility. Conservation Tillage Systems for Energy Reduction. Louisiana State University Agricultural Center.Pub.8910(8M)

Griffen, J.L., Babcock, D.K. 1983. Response of Soybeans to Planting Date in Southwest Louisiana. Louisiana Agricultural Experiment Station. Louisiana State University Agricultural Center.

Harville, B.G., Snow, J.P. 1989 Louisiana Soybean Performance Trials, 1984-1988. Louisiana Agricultural Experiment Station. Louisiana State university Agricultural Center.

He, C., Riggs, J.F., Kang, Y.T. 1993. Integration of Geographic Information Systems and A Computer Model to Evaluate Impacts of Agricultural Runoff on Water Quality. Water Resources Bulletin. American Water Resources Association. Vol.29(6) pp.891-900.

Hutchinson R.L. 1995. Cotton Stand Establishment. Louisiana State University Agricultural Center. Conservation Tillage Systems for Energy Reduction. Pub.8906(8M).

Kelly, S., Barnett, J.W., Micinski, S. 2000. Cotton Insect Control 2000. Louisiana State University Agriculture Center. Pub.1083(6M).

Lee, J.J., Philips,D.L., Dodson, R.F., 1996. Sensitivity of the US Corn Belt to Climate Change and Elevated CO2: II. Soil Erosion and Organic Carbon. Agricultural Systems.**52** (1996) pp. 503-521.

Lencse, R. J., Miller, D. K. 1999 Controlling Weeds in Cotton. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Lencse, Reed. Faw, Wade. 1998. Controlling Weeds in Sugarcane. Louisiana Cooperative Extension Service. Louisiana state University Agricultural Center.

Lindau, C.W., Delaune, R.D., Alford, D.P. 1996. Monitoring Nitrogen Pollution From Sugarcane Runoff Using 15N Analysis. Water, Soil and Air Pollution. Vol. 89. Pp. 389-399.

Louisiana Department of Environmental Quality. 1987. Waste Load Allocation for the Vermillion River. Intensive Survey and Ancillary Data. Appendix B. Vol.3.

Martz, L.W., Garbrecht, J. Automated Extraction of Drainage network and Watershed Data from Digital Elevation Models. Water Resources Bulletin. American Water Resources Association. Vol.29(6) pp.901-908.

McClain, W.R., Bollich, P.K., Gillespie, J.M. 1997. Relaying: An Intercropping Approach to the Co-Culture of Crawfish and Rice. Louisiana State university Agriculture Center. Louisiana Agricultural Experiment Station.

Millhollon, E.P., Melville, D.R. 1991. The Long-term Effects of Winter Cover Crops on Cotton Production in Northwest Louisiana. Louisiana State university Agricultural Center. Louisiana Agricultural Experiment Station.

Morrison, Walter C., 1983. Grain Sorghum in Louisiana. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Morrison, Walter. Morgan, Donna. Anderson, Rusty. 2000. Soybean Variety Recommendations and Production Tips. Louisiana State University Ag. Center Research and Extension.

N.R.C.S. 1995. Revised Universal Soil Loss Equation. Technical Guide, Notice#153. Alexandria, La.

NG Kee Kwong, K.F., Deville, J. 1993. The Course of Fertilizer Nitrogen Uptake by Rainfed Sugarcane in Mauritius. Journal of Agriculture Science. (1994) Vol.122. pp.385-391.

Orellana, F.X. (1992). Characterization of Effluents from Commercial Crawfish Ponds in South Louisiana. A Thesis. Louisiana State University, M.Sc. The School of Foresty, Wildlife, and Fisheries.

Overstreet, Charles. Berggren, G.T.1981. The Soybean Cyst Nematode In Louisiana.

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, And D.C. Yoder coordinators. 1997. Predicting soil erosion by Water: A guide to Conservation Planning With the Revised Universal Soil Loss Equation(RUSLE). U.S. Department of Agriculture, Agriculture Handbook No. 703, 404 pp.

Renolds, D.B., Rogers, L.R., 1995. Preplant Weed Control in Cotton. Louisiana State University Agricultural Center. Conservation Tillage Systems for Energy Reduction. Pub.8909(8M).

Ricaud, R., Landry, G. 1976. Effects of Rate of Planting on Yield and Some Yield Components of Sugarcane. Louisiana State University and Agricultural College. Center for Agricultural Sciences and Rural Development.

Savabi, M.R., Scott, D.E. 1994. Plant Residue Impact on Rainfall Interception. Transactions of the ASAE. 1994 American Society of Agricultural Engineers. Vol. 37(4): pp. 1093-1098.

Semenzato, R. A Stimulation Study of Sugar Cane Harvesting.1994. Agricultural Systems. Vol. 47. Pp. 427-437.

Southwick, L.M., Willis, G.H., Johnson, D.C., Selim, J.M. 1994. Leaching of nitrate, Atrazine, and Metribuzin from Sugarcane in Southern Louisiana. Journal of Environmental Quality. Vol.24. pp.684-690.

Tidwell, E.K., Redfern, D.D. 1997. Forage Testing: Why, What and How. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Tidwell, Ed. Brown L.P. 1999. 1999 Recommended Wheat and Oat Varieties and Management practices. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Vidrene, Roy., Millhollon, E.P. 1999. Control Weeds In Soybeans. Louisiana Cooperative Extension Service. Louisiana State University Agricultural Center.

Zhang, X.C., Nearing, M.A., Risse, L.M., McGregor, K.C. 1996. Evaluation of WEPP Runoff and Soil Loss Predictions Using Natural Runoff Plot Data. Transactions of the ASAE. American Society of Agricultural Engineers. Vol.39(3) pp.855-863.